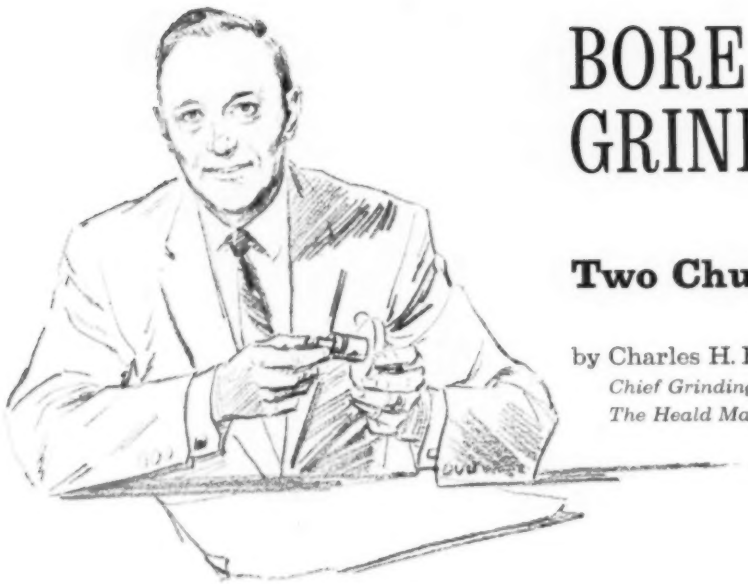
# the TOOL and MANUFACTURING ENGINEER

MAY 1961

exposition issue

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS



# BORE AND FACE GRINDING...

## Two Chuckings or One?

by Charles H. Hall
*Chief Grinding Engineer*
*The Heald Machine Company*

Many parts that call for an internal grinding operation also require precision finishing on an adjacent or associated face. This poses no particular problem, of course, and it usually presents an opportunity to make substantial savings by combining the two operations on a single machine.

The conventional method of grinding the bore on one machine and the face on another has some inherent disadvantages. It means two separate loading and grinding operations plus additional handling between machines. And since two chuckings are involved, the relationship between bore and face is subject to squareness variations which may or may not be serious.

If, on the other hand, the bore and face can be done at a single chucking, total floor-to-floor time can be greatly reduced. But even more important is the fact that squareness between bore and face can be positively assured.

Combined bore and face grinding has been standard procedure with certain types of work on Heald two-spindle internals for many years. Several different methods can be employed, each of which has its own merits for a particular application.

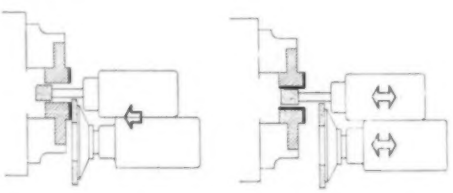
Where cycle time must be kept to the minimum, slide-bar facing offers maximum efficiency and economy, for both surfaces are ground *simultaneously*. One wheelhead unit mounted on anti-friction slide bars holds the facing wheel in grinding position while a second wheelhead unit reciprocate grinds the bore.

Where high production requirements are not a limiting factor, initial machine cost can be lowered by using a two-spindle machine arranged for sequential bore and face grinding, either with or without indexing of the wheelheads. Where bore tolerances are extremely close and indexing is not desired, fixed wheelheads can be arranged to permit manual plunge facing while the bore wheel enters the work without touching it. The table is then backed off to reciprocate-grind the bore.

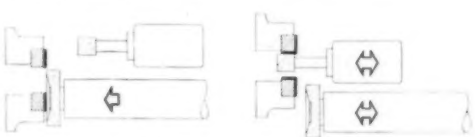
Where indexing is permissible, a retractable facing head is often used. After the work is plunge faced, the facing head is retracted and table is indexed to align the bore wheelhead unit with the hole. This arrangement provides maximum versatility and permits the machine to be used as a bore grinder, a face grinder, or a combination of both.

Whatever your requirements for bore and face grinding, it is probable that one of these two-spindle arrangements can be applied with a substantial reduction of initial investment, lower floor-to-floor cycle time and an improvement in quality as well.

Diagrams of slide-bar facing arrangement showing semi-finish bore grinding and face grinding at left and finish bore grinding at right.



Diagrams of sequential bore and face grinding with fixed wheelheads, showing face grinding at left and bore grinding at right.



Diagrams of sequential bore and face grinding with retractable facing head and cross slide indexing, showing face grinding at left and bore grinding at right.

Ask your Heald engineer for further details, or send for Bulletin 2-69-2. **It PAYS to come to Heald.**

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# the TOOL and MANUFACTURING ENGINEER

Vol. 46
No. 6

May
1961



**Revolution in Manufacturing—Part 1** ..... *By T. W. Black* 81
Application of science to manufacturing can have a revolutionary impact. More research will make the revolution a reality.

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**Electromagnetic Metal Forming** ..... *By A. P. Langlois* 105
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**Clamping Thin Skins** ..... *By F. M. Partridge* 109
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**Machining Shafts Straight** ..... *By Joseph C. Bott* 111
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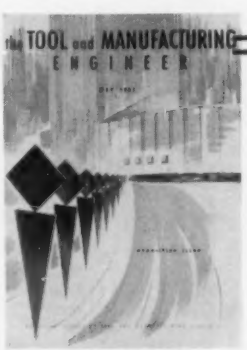
## THIS MONTH'S COVER

More than 40,000 manufacturing engineers and executives are expected at ASTME's 1961 Tool Exposition at the New York Coliseum, May 22-26. Many of those attending will also take advantage of the opportunity to learn more about the latest advances in scientific manufacturing at the ASTME Engineering Conference, which runs concurrently. Something of the spirit of both events is captured by the cover illustration. A 32-page pictorial preview starts on page 129.





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## Let's Keep Ahead

The amount of research and development work that an organization does today will be a measure of that organization's growth tomorrow. In the past, investment in research has been a major reason for the success of many large companies. To make the argument convincing, these companies themselves have acknowledged the role of research in their success.

Yet many companies still engage in little or no research. In addition, when business is slow, as at present, they cancel appropriations that may have been set aside for this purpose. With ample time and talent available, they disregard the fact that a slack period provides an excellent opportunity to gather useful data and accelerate new developments. This is the best way to lead an industry out of the doldrums.

Manufacturing is the largest single area of our economy as far as engineering is concerned, yet the University of Texas reports "there is not a single solitary machine tool builder, tool and die manufacturer or any related company directly sponsoring a fellowship or scholarship at this college." How many other universities would report the same?

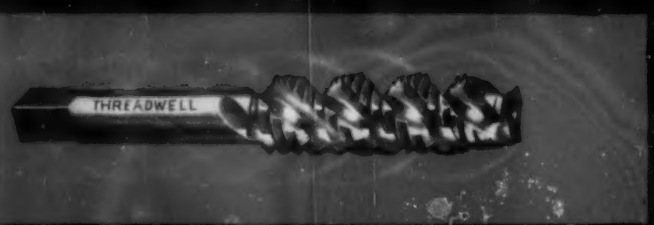
Manufacturers may feel that money is not available for research and that capital must be invested for quick return. This is unfortunate. Many machine tool companies have invested in Europe and have built plants there. This has proved fruitful because productive machines are manufactured and sold at competitive prices. Both parties to the transactions profit, necessary elements in a balanced economy. What would be better than to reinvest these profits in research at home?

Those who are not looking ahead through R&D will regret the fact as they see their markets dwindle. According to the U of Texas, an industry is dead if it does not recognize the importance of research. Research creates answers which were heretofore unavailable. It creates designs and equipment heretofore impossible and generates ideas to improve the work being done.

John W Greve

EDITOR

# Only TURBO-CUT by Threadwell has a full 3-4 thread plug chamfer!

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# preview

*. . . a fast look at this issue*

**Revolution in Manufacturing?**

Yes, says senior associate editor Ted Black, there can be a major revolution in manufacturing during the next 25 years, provided that certain obstacles in the pathway to manufacturing progress are removed. His article, starting on page 81, says that two of the major obstacles are the lack of a sufficient number of tool and manufacturing engineers with advanced scientific training and the lack of truly broad—and deep—research into some of the fundamental scientific problems that must be solved if industry is to advance at an accelerated rate. Next month he will assume that these problems have been solved and will discuss the plant of the future.

**Revolution in Metalcutting Research?**

Dr. Max Kronenberg, world-renowned authority on all aspects of the metalcutting process, has applied dimensional analysis—a mathematical tool that has yielded much valuable information in hydraulics and aerodynamics—to metalcutting research. Putting this tool to work, Dr. Kronenberg shows how some surprising phenomena can be predicted. At ultrahigh speeds, cutting speeds should be increased, rather than decreased. This prediction is borne out by experimental work at Lockheed, previously described in this magazine. The article starts on page 90.

**More About Tracer Machines**

In this issue, J. B. Bryan and his colleagues at the University of California's Radiation Laboratories continue their article on finding and correcting the causes of tracer lathe inaccuracies. Part 2 of their article starts on page 93. And associate editor Bob Heslen describes a new tracer machine that is capable of holding accuracies measured in millionths of an inch. His article starts on page 101.

**Fabricating Parts for the Space Age**

Two relatively new methods for forming sheet-metal parts are discussed in this issue. In an article starting on page 105, A. P. Langlois of Convair's Applied Manufacturing Research department, tells about electromagnetic forming. Unseen but powerful magnetic forces can exert enough pressure on conductive metals to exceed elastic limits and cause the metal to conform to the shape of a die or mandrel. G. C. Throner of Aerojet-General's Ordnance Div. shows how explosive forces are utilized to form, forge and compact Space-Age metals in a comprehensive article starting on page 123. Speaking of Space-Age materials, the Reference Sheet starting on page 127 gives the latest speeds and speeds information for milling high-strength alloys.

**Some Uses of Air Pressure**

General Electric engineers Donald Dutt and Howard Mather point out that air pressure has its uses when curing plastic tools and silicone rubber molds. Pressure curing eliminates bubbles and insures close fidelity to the pattern or model used. Their article, starting on page 121, gives the details.

Another use of air pressure is the topic of F. M. Partridge's article, page 109. Partridge, a Chance-Vought research engineer, shows how vacuum chucks can be used to hold thin, fragile workpieces for precision machining. The part is sealed to the fixture, air is exhausted and atmospheric pressure holds the workpiece, which does not twist or distort.

**Machining Laminated Plastics**

Drilling and countersinking glass laminated materials can present problems. There is a tendency for the fibers to break on entry or breakout of the drill and the work material may be torn. A backup material described by Grumman Aircraft engineers William Thomas and Sheldon Meyers, page 103, has solved this difficulty.

**Productivity '61**

Productivity '61—the ASTME New York Engineering Conference and Tool Exposition, May 22-26—is the biggest event of the year for tool and manufacturing engineers. During the course of the week, more than 50 speakers will discuss dozens of new developments in manufacturing and some 300 exhibitors will display hundreds of ways to cut manufacturing costs. A 32-page preview starts on page 129.

AT THE FULTON SYLPHON DIVISION
Robertshaw Fulton Controls Co.
Knoxville, Tenn.

# 300 complex jobs a year set up with standard tooling on four bar automatics

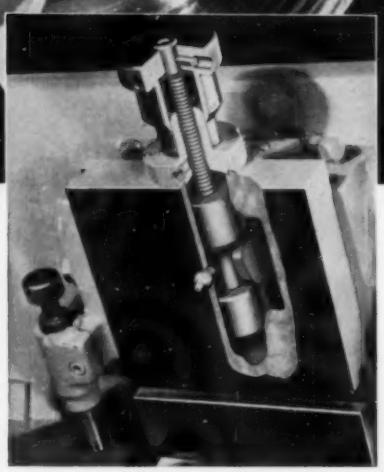
**Tooling cost and setup time is kept under rigid control by interchangeable standard tools and "camless" features of Warner & Swasey Multi-Spindle Bar Automatics.**

Fulton Sylphon makes 3200 different control components to which they add, each year, nearly 200 new machined parts. They now keep both inventories and costs in line by "automating" production in lot sizes of 100 to 7000 pieces (average is 1000). Formerly this work was done on hand turret lathes.

Their Warner & Swasey Multi-Spindle Automatics hold tolerances to .001/.0015" without costly shaving tools. Work materials are corrosion resistant stainless steels, monel, aluminum bronze and phosphor bronze in a wide variety of complex shapes.

Typical of easy setup is the fact that their oldest Warner & Swasey Automatic has "set up and run" 9 different jobs on 10 straight shifts.

Get the facts on these bar automatics from your Warner & Swasey Field Engineer. Warner & Swasey Company, Cleveland 3, Ohio.



Specially designed spindle drum stops for the cross slides are only one of many features which result in holding .001" tolerances on small lot, complex jobs in tough materials.

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# LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Engineers' salary levels have been rising at a rate of five percent a year for the past several years, according to a survey made by the Engineering Manpower Commission of EJC and the Scientific Manpower Commission. The over-all median annual salary now stands at $9600, as compared to $6500 in 1953. Despite this rise in engineers' salaries, freshman enrollment in engineering schools has dropped.

A gradual upturn in the machine tool industry, beginning in the second half of this year and extending well into 1962, at least, is foreseen by the Value Line Investment Survey. Machine tool orders during 1962 should be 20 percent above the 1961 total and this prospective advance could become explosive if the automakers should accelerate their new engine programs or if the upward momentum of the economy should tax present productive capacity of the machine tool industry's other customers.

Hughes Aircraft is using a computer technique called "job shop simulation" to eliminate costly trial-and-error methods of improving shop performance. An entire month's work can be represented on a computer in 15 minutes. Alternate management plans and key facts about a production line are entered on punch cards and fed into the computer, which digests the information, then spews out the results to be achieved from each of the proposed plans. Management can then select the best solution.

In a survey of technical advances in stainless steel, the AISI Committee of Stainless Steel Producers reports that explosive bulging, swaging and flanging of stainless hollow shapes is commercially feasible. Mild drawing with explosive energy is also practical. Explosive extrusion of stainless shapes, under consideration, is not yet practical. Explosive compaction of stainless powder results in good, dense structures and opens the way to low-cost production of highly complex shapes in stainless.

A method of producing corrugated-core sandwich panels that reduces cost substantially has been developed in research sponsored by the Douglas Aircraft Co. at Battelle Memorial Institute. The process—called roll-welding—uses hot rolling to pressure-weld the peaks of the corrugated metal core to the cover sheets. One-fourth-inch-thick panels as large as 72 x 36 inches have been produced. The panels can be extensively formed after assembly.

Kolene Corp., Detroit, Mich., has developed a jet-spray process for applying molten salt to continuously moving strip. This process will have application for the descaling of stainless steels. In production, strip leaves the annealing furnace, goes between jet-spray heads and through a pickle bath. It is then dried by heated air blasts before it is coiled. Advantages of the process are low equipment and operating costs, and scratch-free cleaning.

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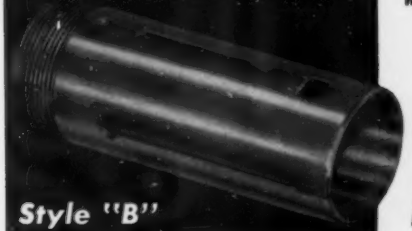

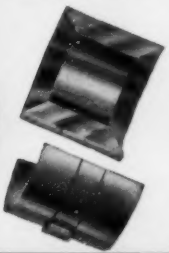

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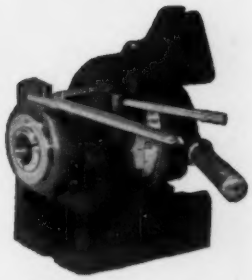

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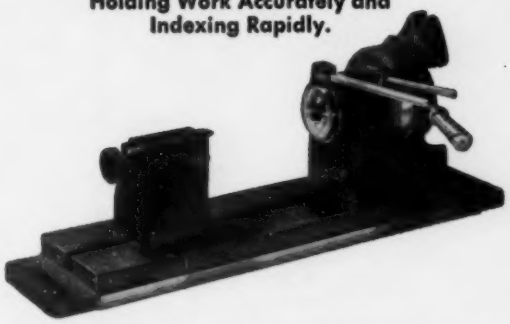

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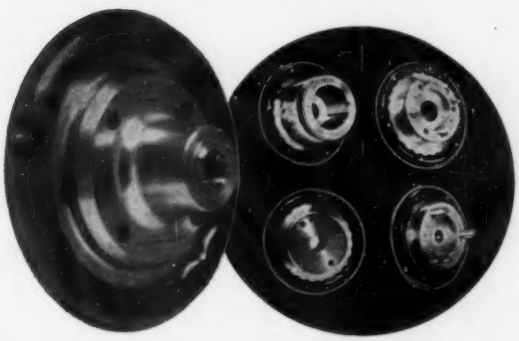

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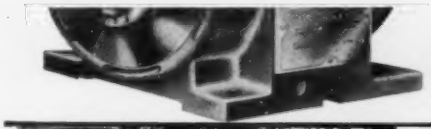

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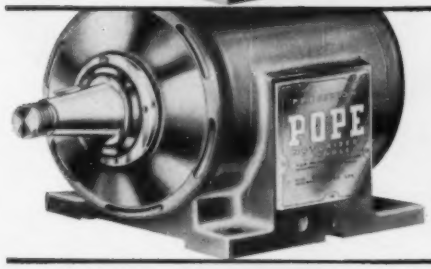
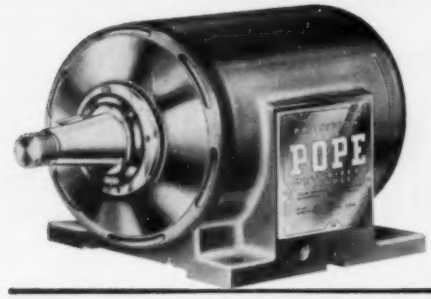


# PRECISION MOTORIZED SPINDLES



**.000025″ (twenty-five millionths) vibration amplitude**

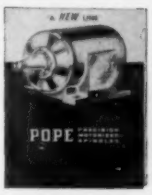
**.000075″ (seventy-five millionths) shaft runout**

**1 to 20 horsepower — 900 to 3600 r. p. m.**

Use this heavy duty, motorized unit for a wide variety of precision grinding and cutting operations.

Use it to drive precision machine tool spindles, test apparatus or research equipment.

Use it wherever low amplitude of vibration and *extra rigidity* mean more profit for you through better, faster production.



Bulletin S-23 gives you complete information, dimensions and specifications. May we mail you a copy?

This Pope Precision Motorized Spindle is equipped with a Pope balancing type wheel holder for precision grinding.

NO. 135

**POPE®**

**ENGINEERS, DESIGNS AND BUILDS PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE**

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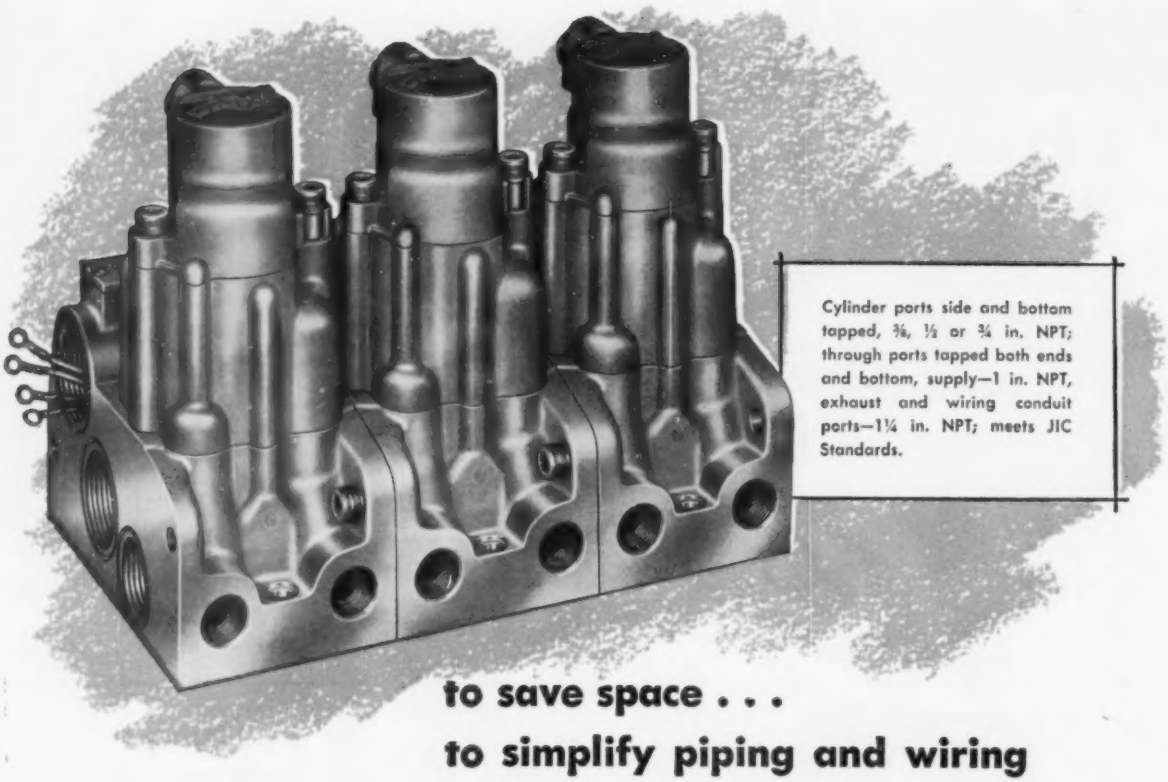

Cylinder ports side and bottom tapped, ⅜, ½ or ¾ in. NPT; through ports tapped both ends and bottom, supply—1 in. NPT, exhaust and wiring conduit ports—1¼ in. NPT; meets JIC Standards.

**to save space . . .**

**to simplify piping and wiring**

# New PDQ MODULAR MANIFOLD BASE

Now you can save even more space by ganging already-compact Hunt ½ in. PDQ valves on modular manifold bases!

Featuring common supply, exhaust and wiring conduit ports, PDQ modular manifold bases can be ganged end-to-end to manifold two or more valves in a single, compact assembly. Manifolding of valves simplifies supply and exhaust piping, reduces installation costs and minimizes mounting space requirements for multiple valve installations. Modular design permits adding or removing valves at a later date, to meet changing requirements. Also, bottom tapping permits additional supply, exhaust, or wiring connections at any point along the manifold assembly, if required.

Electrical connections, valve-to-base, are plug-in, to reduce downtime to a minimum. What's more, the bayonet-lock construction of Hunt's PDQ valve allows removal and installation of valve and pilot assembly in just 30 seconds, without disturbing piping or wiring.

Whether your problem is limited valve mounting space . . . complex piping . . . high installation costs . . . or you're just looking for better, lower cost, more dependable performance on new or existing equipment, ask your nearby Hunt representative to show you the advantages of modular manifold base-mounted PDQ valves.

For more information, write for Bulletin 602. Address Hunt Valve Company, Salem, Ohio, Dept. TE-561.

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**QUICK-AS-WINK® AIR AND HYDRAULIC**

**VALVES**

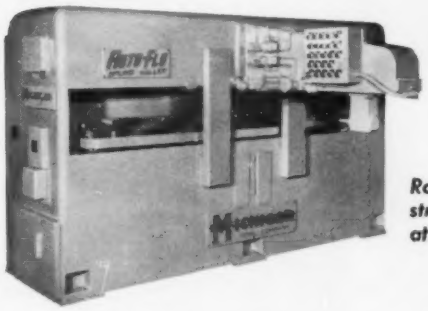
HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

3014

# SOLUTIONS TO GEAR PROBLEMS

PROBLEM: **TO BOOST TRACTOR AXLE SPLINE STRENGTH WITHOUT HIGHER COST**

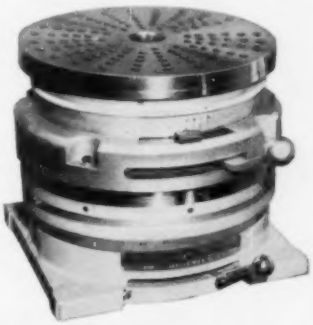
To increase strength of tractor axle shafts produced by a major manufacturer without increasing diameter, Michigan recommended the use of a Roto-Flo machine to cold roll the splines. This resulted in a 60% increase in torque load capacity due to the cold working at the normally weakened section. The "chipless machining" process reduced stress concentrations by 37% and increased production rate three-fold over the slower previous hobbing method. The same machine is used for different sizes of shafts. There were also major savings in tool costs over hobbing.



*Roto-Flo gives stronger splines at lower cost*

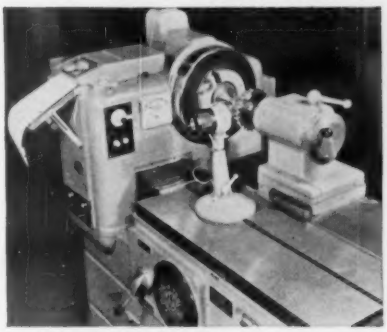
PROBLEM: **NEEDED FAST ACCURATE INDEXING IN ¼ DEGREE INCREMENTS**

Operations performed on a missile part required extremely accurate indexing in quarter degrees. Precision indexing tables used before required special gage blocks, trigonometry tables and a lot of time. Michigan's answer was a double table version of its Milichex rotary indexing table. This new version, Model M2X-900, provides instant indexing to ¼ degree settings with an accuracy of ¼ second of arc. No gage blocks or trig tables are needed. Operator merely indexes upper and lower tables to proper settings and Milichex automatically locks into exact angular position.



*This Milichex indexes in ¼° increments*

PROBLEM: **100% CHECK OF GEAR TOLERANCES TO TENTHS IN PRODUCTION**

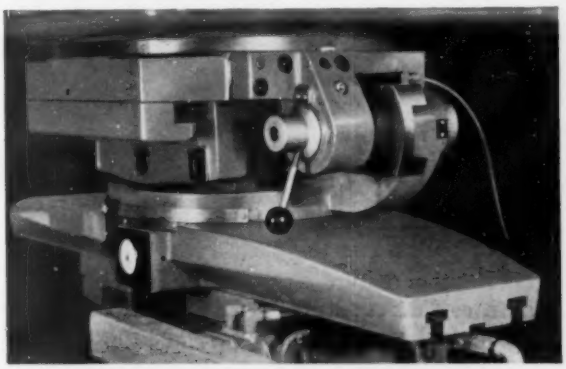


*Production lead checking to laboratory tolerances on a 1218-A*

A jet engine production bottleneck was the time required to accurately check the lead angle of gears to 0.0003 inch. A Michigan Sine Line 1218-A Lead Checker answered this need. Originally a 'laboratory' type checker, the machine with its precision optical system eliminates the need for "operator feel", records all checks, has the ruggedness for continuous production checking.

PROBLEM: **TO SHAVE ANY COMBINATION OF CROWN & TAPER ON SAME MACHINE**

Solved by a compact attachment for the Mark II shaving machine. Setting permanently installed attachment to scale controls amount of taper. An eccentric bushing in the attachment controls taper independently. For uncrowned untapered gears, both are set to 'zero'. Gears can be tapered or crowned with either transverse or modified underpass method. For spur gears, underpass method can also be used.

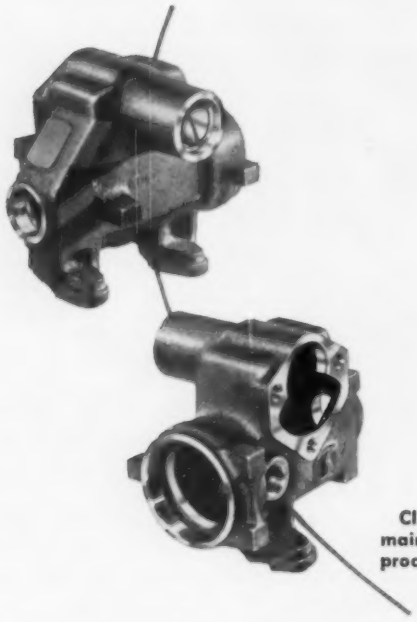


*Taper & crown attachment for the Mark II gear shaver*

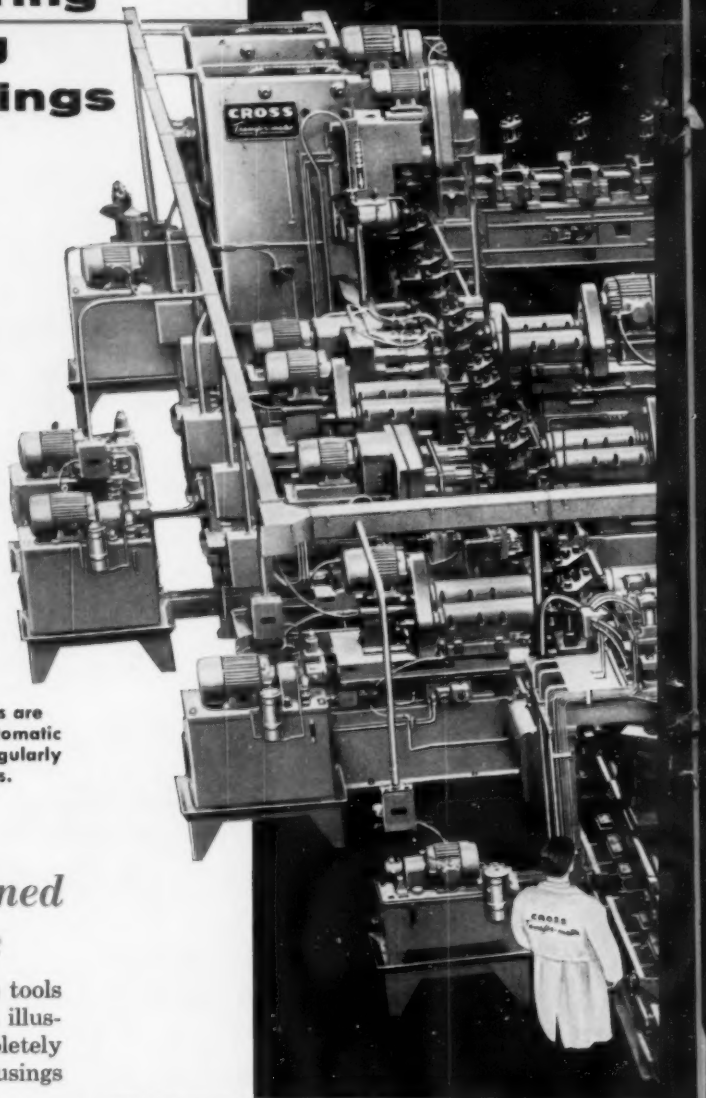
**MICHIGAN TOOL COMPANY,** 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

Use Reader Service Card, CIRCLE 15

# Milling, Drilling, Boring and Assembling Steering Gear Housings



Close tolerances are maintained in automatic processing of irregularly shaped parts.




## *New Transfer-matic Designed to Prevent Obsolescence*

A typical example of how transfer type machine tools can be designed to guard against obsolescence is illustrated by this new Cross Transfer-matic. It completely machines and assembles power steering gear housings except for the mounting feet.

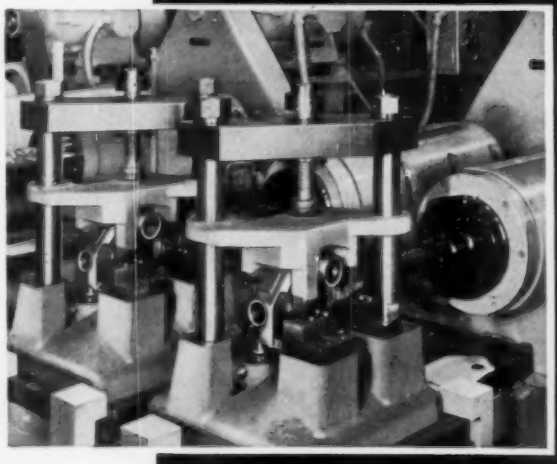
Useful life has been materially increased by building the Transfer-matic to process housings with longer pitman shaft extensions than those now being produced. Three idle stations permit other operations to be added and the use of standard Cross "building blocks" provides further flexibility for part design changes.

Present operations include milling, drilling, boring, counterboring, spot facing, chamfering, tapping, deburring, and assembling the worm thrust bearing cups and the pitman shaft bushings in the housings. Rated production is 300 pieces per hour.

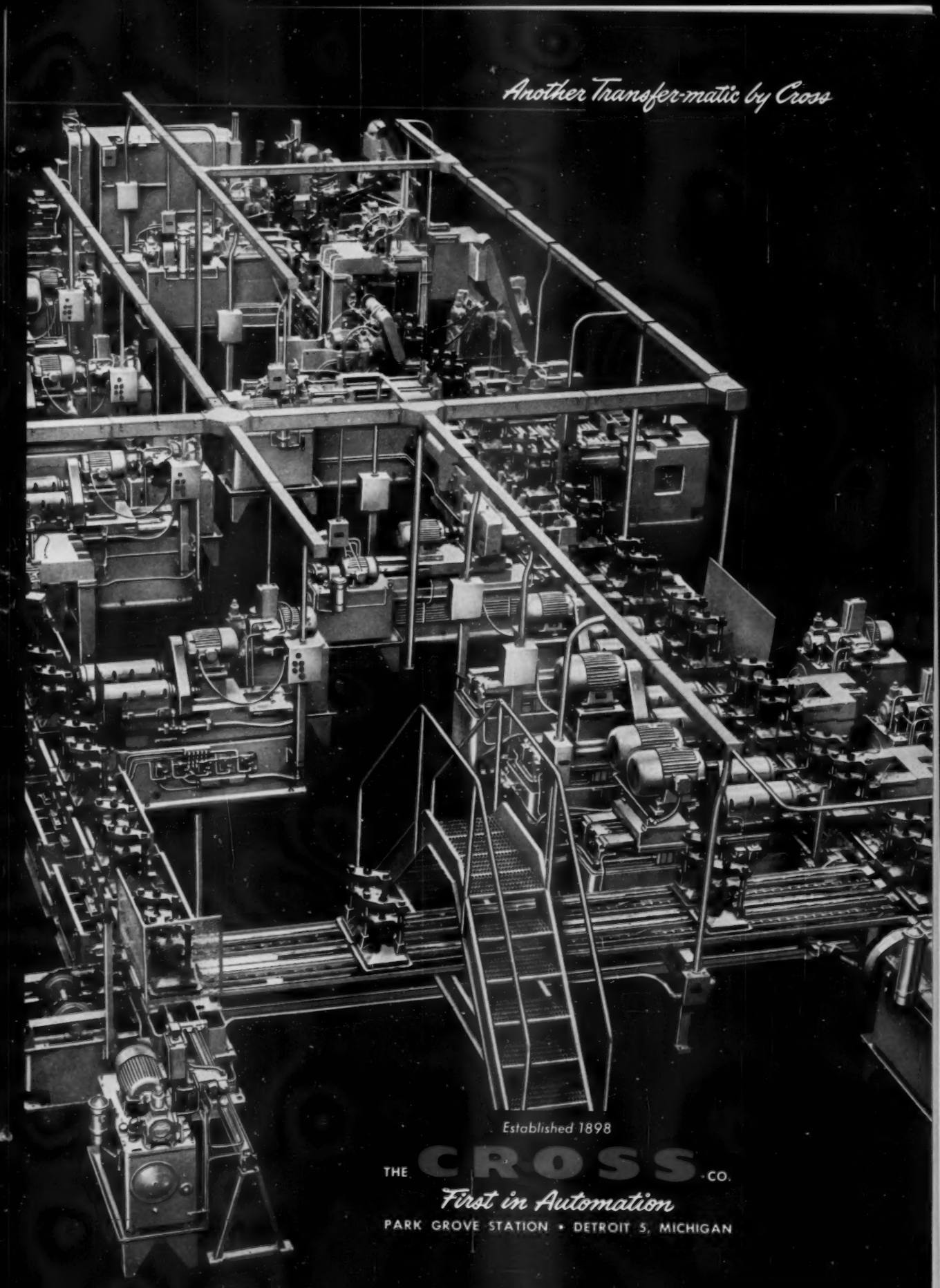
A special feature is the provision for off-line inspection of the pallets and the parts without loss of production.

Another feature is the provision for in-line inspection at three different stations and final inspection just before the assembly operations.

If you would like to know more about these and other Cross innovations, just drop us a line.



Precision boring of the worm shaft hole—two at a time.

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*First in Automation*

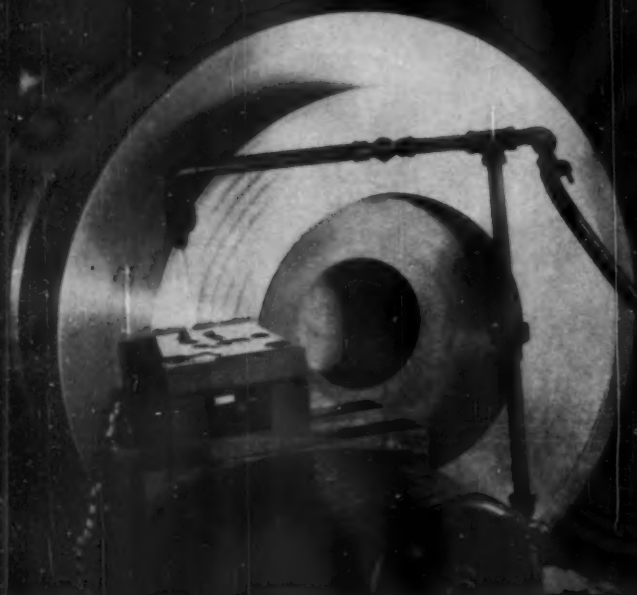
PARK GROVE STATION • DETROIT 5, MICHIGAN

use Airpower–not Manpower*

# CUSHMAN

## AIR OPERATED CHUCKS AND CYLINDERS

* Cushman Air Operated Chucks speed production and improve product quality, eliminate fatiguing hand wrenching, plus related rejects and accidents.



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*Cushman also manufactures manually operated chucks, power wrenches, and face plate jaws.*

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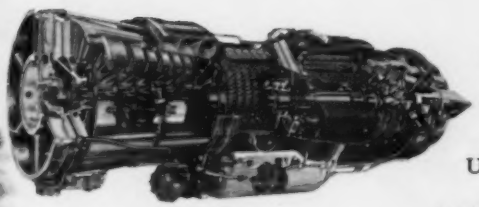
# Production Pointers

from GISHOLT

More cost-cutting IDEAS—
to help you

## NEW BALANCING METHODS SAVE FOR UNITED AIRLINES

***Two units, one automatic . . . one double-tooled, speed maintenance balancing of jet engines . . .***

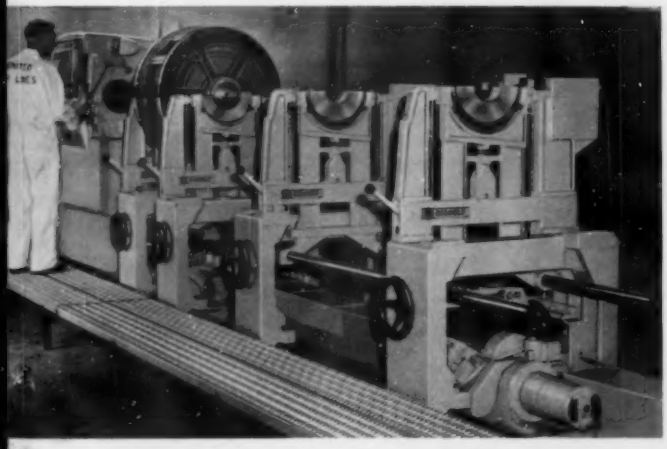


JT-3 Jet Engine

Unbalance causes vibration, and trouble . . . especially in the rotating heart of a jet engine. To assure continued safe operation, jet engines must be overhauled periodically. This installation in United Air Lines' Turbine Overhaul Facility, at San Francisco's International Airport, shows how low cost and peak efficiency can be obtained in maintenance balancing operations.

United Air Lines uses Pratt & Whitney JT-3C6, JT-3C7, JT-4A3 and JT-4A9 engines. Two Gisholt Balancers were selected for this installation. They had to comply with rigid performance tests based on Pratt & Whitney's specs. They also had to offer fast changeover, low tooling costs, and capacity for all parts and assemblies for all four engines.

A vertical 2SV1 Balancer is used for separate components requiring single plane (static) balancing. During rotation the 2SV1 automatically remembers angle and shows amount of unbalance in terms of the correction method used. After rotation, the operator indexes the part until a light flashes, indicating where correction should be made. All seven stages of a low compressor can be balanced, corrected and inspected in less than one hour.



Gisholt UJP Balancer with two sets of work supports. Shown with a JT-3 Rear Compressor assembly in one set of supports. The other set has been readied for a different type of part. Setups can be made for two plane balancing, or single plane (static) with a check for moment unbalance.

Gisholt 2SV1 Balancer arranged to balance front compressor part. A safety clamp device which fits over the center of the part has been removed to show detail. Power loader moves work from conveyor to spindle adapter. During work rotation operator notes amount . . . selects corrections weights. He stops rotation, indexes work to angle and makes correction. Work is rotated again to inspect for balance. Total time—2 minutes.

Even though components are balanced separately, tolerances accumulate during assembly. Complete units must also be balanced in their own bearings. Some weigh as much as 1500 lbs. This work is done on a Gisholt UJP Balancer. Special foundations are not required although vibrations as small as .000007" can be measured and located.

The UJP Balancer has two complete sets of work supports. One can be set up for a new part while the other is in use. Non-operating time is at a minimum. Two-machine production is obtained at 1½ times the original cost of a single machine.

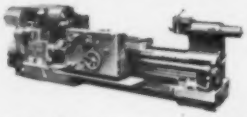
Here are typical balancing times: high turbine—5 minutes; low turbine—½ to 1 hour; high compressor—½ hour; low compressor—1 to 1½ hours. This includes loading, location, measurement, correction and inspection for balance.

***Gisholt Balancers save time, offer top accuracy, eliminate guesswork. Special UJP Balancer gives two-machine production at cost and floor space of 1-1/2 units.***

***For information on Balancers, circle No. 750 on inquiry card.***

## HARNISCHFEGER SAVES UP TO 30 MINUTES PER PART WITH GISHOLT CRI-DAN

### . . . Single-point tools thread tough steel to high accuracy . . . fine finish



Want to cut costs from 30% to 80% on the toughest threading jobs in your plant? Then study this setup at Harnischfeger Corporation, Milwaukee, Wisconsin. It shows how you can use inexpensive single-point carbide and high speed tools to produce top quality threads, simple or complex, automatically!

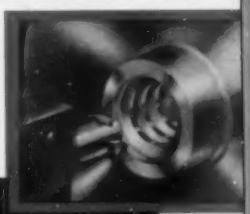
Harnischfeger produces a wide variety of industrial equipment requiring many types of threads in many different materials. The Cri-Dan technique was investigated as a possible means of reducing time and tooling costs of conventional methods. As a result, a Gisholt Cri-Dan E Automatic Threading Lathe was installed to handle a group of power hoist parts. Work included external threading on 15 different pinion shafts and worms and internal, 2-start threading on 8 different gear blanks.

The savings obtained on the 10″ steel gear blank setup shown are typical. It requires a .250″ deep, 1″ lead, 2-start Acme thread for a length of 2⅛″ in the 2″ bore. Brinell hardness is 269-302. Five taps were previously used, requiring 37 minutes to complete the thread. On the Cri-Dan E, work is chucked once . . . in a 12″ 3-jaw air chuck. The automatic cycle is started and the single-point tool completes the 2-start thread in 100 passes. Tool infeed diminishes on the last 6 passes providing a 125 micro-inch RMS finish. Floor-to-floor time is only 9 minutes.

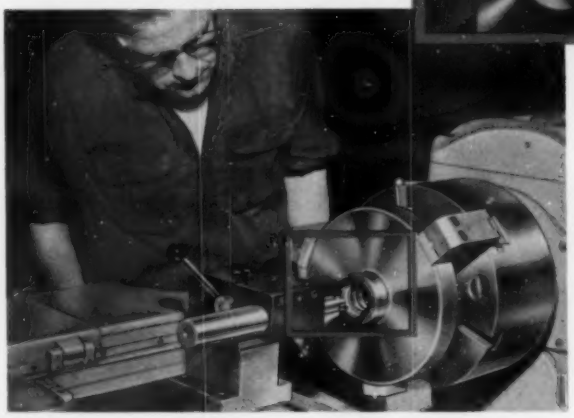
***Cri-Dan technique saves 30 minutes on this part. Tool costs and setup times have been reduced and a better quality thread and finish is obtained. Time savings average 60% on all parts handled.***

***For information on Cri-Dan E, circle No. 751 on inquiry card.***

Close-up of 2-start thread and tooling. ▶

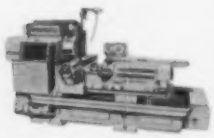


Single-point tool produces two-start thread in only 9 minutes f.t.f. compared to 37 minutes by previous methods. Inexpensive tooling, fast setup and versatility to handle all types of threads make the CRI-DAN pay off in any shop . . . large or small. ▼



## AUTOMATICS DOUBLE PRODUCTIVITY...CUT TIME 65% AT BODINE ELECTRIC

### . . . Six automatics replace 8 manual turret lathes, handle increased production . . .



How much could you save if you had Automatic Ram Turret Lathes in your shop? The results obtained by Bodine Electric, Chicago, Ill., provide some revealing answers to this question.

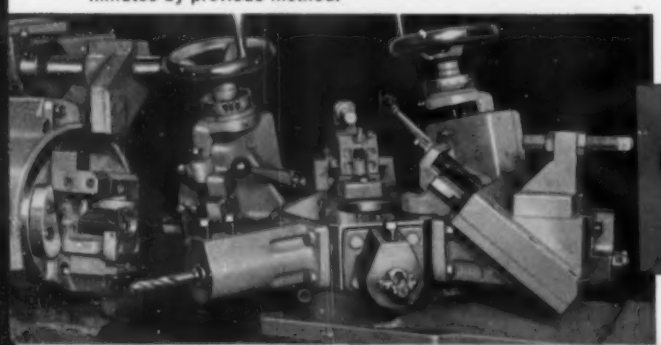
Bodine Electric is a well-known manufacturer of fractional h.p. motors. Components, such as worm gear housings, end shields, gear blanks, and gear shafts, were being machined on hand operated turret lathes. Analysis showed that greater efficiency was needed to keep costs in line, maintain the profit ratio and meet an anticipated production increase.

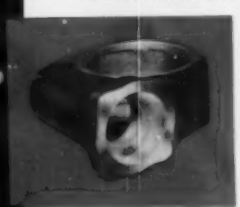
Various automatic lathes were evaluated. The Gisholt MASTERLINE Automatic Ram Turret Lathe was selected as the machine that would best meet their needs.

Here are the results of this important decision. Six machines, purchased over a period of time, do work previously done on 8 manual turret lathes and handle the increased production too . . . now over 360,000 units a year. Based on previous methods, floor space requirements were cut in half. The new Gisholt Automatic Rams gave them the capacity and versatility of a turret lathe with a fast automatic cycle, reducing operator effort to loading, starting the cycle and unloading. On bar work even less is required Each operator handles two machines doubling individual productivity. Standard tools, already available could be used. Except for programming the cycle, setup methods were unchanged. Setup times were almost as low as for manual turret lathes.

Machining time was cut an average of 65% on *all* parts handled. Uniform quality, longer tool life and consistent production rates were other plus factors . . . with each automatic ram costing less than 1½ times the initial cost of a manual turret lathe!

Automatic Ram Turret Lathe tooled to machine flange end of worm gear housing.
Fixture adjusts for various sizes. Cycle includes use of multi-diameter cutter, drill, and automatic slide tools that quickly adjust for other sizes. Reverse feed provides close tolerance, fine finish needed. Time . . . only 1.3 minutes f.t.f. compared to 3 minutes by previous method.



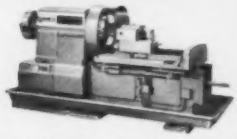


***Six automatics do the work of 8 manual lathes and meet increased production requirements. Each operator handles two machines. Time cuts average 65% on all work handled. Fast setup and automatic cycle up profits on small lots or long runs.***

***For information on AR, circle No. 752 on inquiry card.***

# PRE-SET TOOLS SIMPLIFY GROOVING FOR CHICAGO PNEUMATIC TOOL COMPANY

## . . . One basic setup covers three operations on wide range of work



If deep grooving is one of your production problems, you'll want to study this setup. It shows how Chicago Pneumatic Tool Co.'s Oil Tool Div., Fort Worth, Texas, uses pre-set tooling and Simplimatic versatility to cut costs.

Workpieces are AISI 4815 steel oil well cutter bit forgings. Over 12 different sizes, from 5⅜" to 12¼" are produced. Previous blanking operations are handled on Gisholt No. 12 Automatics. Grooving work, on the three different cutter types made from each size blank is done on Gisholt Simplimatics.

Tooling is designed for fast changeover. Four sets of special chuck jaws handle all the part sizes. Tool bits are bolted in milled slots on spacer plates and pre-set in the tool room for each part type and size. These are quickly mounted on the slide tops as needed.

On the grooving setup shown, speed is 284 RPM . . . feed is .0045". Both slides operate at the same time, completing the operation in one pass. Although material removal approaches 15-20%, time is only 2.5 minutes, f.t.f.

The Simplimatic was selected because it offered a large platen, upon which standard independent slides could be permanently mounted to cover the entire work range. The slides have swivel bases for speedy angular adjustment. Slide tops have micrometer adjustment, in and out, to minimize tool overhang. This provides rigid tool support for maximum metal removal using a 60 HP motor and long tool life (over 250 parts per grind). Both slides operate simultaneously, keeping cycle time at a minimum.

Basic setup handles grooving operations on cutter bit forgings from 5⅜" to 12¼". Pre-set tools on riser plates speed changeover. Gulfcut H.D. Soluble Oil Coolant reduces maintenance costs, combines with rigid tooling to provide finer finish, longer tool life and maintain .005" tolerance on cone heights and groove depths.

***Simplimatic offers capacity and versatility for wide work range . . . power and rigidity for maximum metal removal and minimum machining times. Pre-set tools cut changeover time . . . increase productivity.***

***For information on Simplimatic, circle No. 753 on inquiry card.***

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# HOW TO SPEED SPHERICAL TURNING OF BALL VALVE PARTS

## . . . Generating head on No. 12 handles over 30 different sizes . . .

Here's a real time-saving setup for generating spherical diameters. Shown on a Gisholt No. 12 Automatic Chucking Lathe, it combines spherical turning, blending, facing and chamfering into one fast, automatic operation.

A wide range of ball valve parts is handled by a spherical generating head on the rear independent slide. Sizes start at ¾". The generating tool holder has micrometer adjustment for up to 5" diameter work.

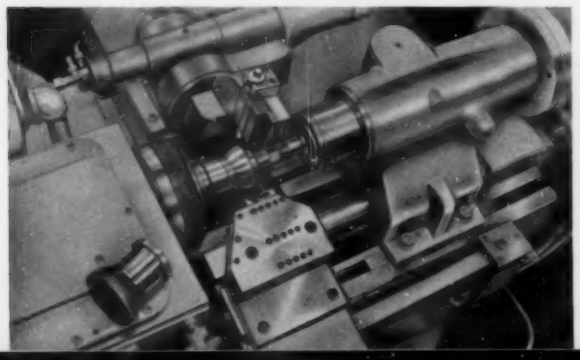
Tooling is designed for quick changeover. An air operated expanding mandrel and a threaded draw bar fixture were supplied to handle parts with smooth or threaded bores. Expansion sleeves, stop collars and drawbar extensions compensate for different lengths and bore diameters. An open-type tool block on the front carriage permits quick adjustment of replacement of other tools.

This is the sequence of the part shown in the illustration. It is held on an expanding mandrel with tailstock support. The 3.500" spherical diameter is generated at .006" feed, 390 SFM. An 80 micro-inch RMS finish is obtained. At the same time, front carriage tools blend at the base of the ball, face to length and chamfer. Time . . . only 1.3 minutes f.t.f. . . . compared to over 3 minutes by previous methods.

A spherical generating head can also be supplied for both rough and finish passes during the automatic cycle.

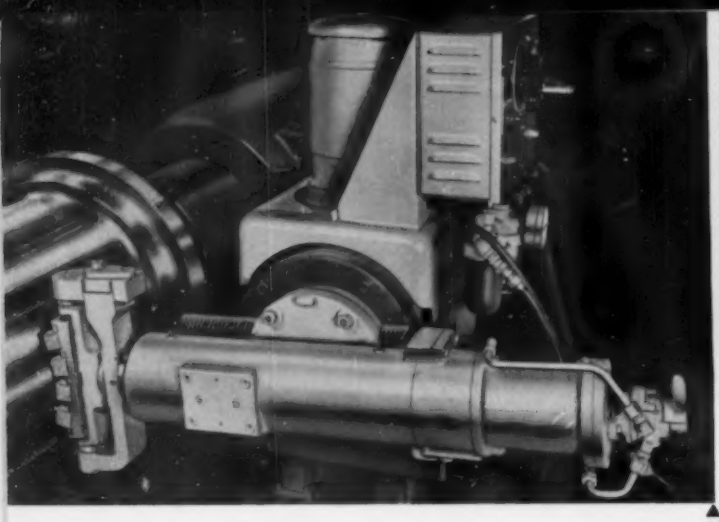
Representative parts showing variety of spherical surfaces machined with this setup. Note that parts have both smooth and threaded bores. The 2" ball at far left is completed at 390 SFM in only .8 minutes f.t.f.

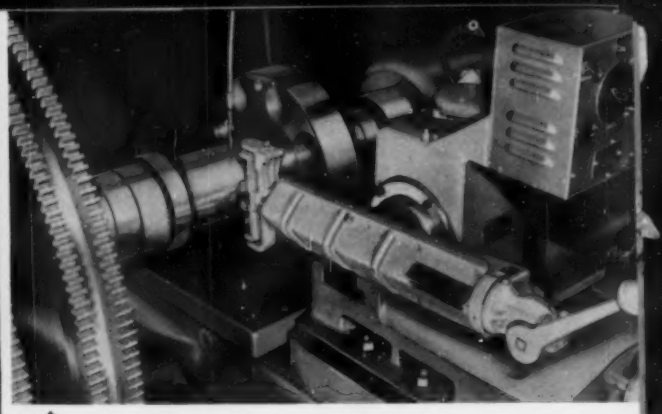
Rough part at left and finished part held on expanding mandrel. The 3.500" spherical diameter is generated while front tools blend, face to length and chamfer. Time . . . only 1.3 minutes f.t.f.



***Spherical generating head turns O.D.'s up to 5" . . . meets close tolerance, fine finish requirements. Fast automatic cycle on No. 12 cuts machining time over 50%.***

***For information on No. 12, circle No. 754 on inquiry card.***





▲ Model 62 Attachment used in Small Turbine Department saves $644 a year on labor costs alone! With traverse provided by tool post carriage, it handles any length within capacity of lathe.

▲ Model 73 Attachment used in Large and Medium Turbine Department handles diameters to 60". Saves 7 hours on large journals . . . provides 5 micro-inch RMS finish.

## WESTINGHOUSE CUTS 7 HOURS ON ROTOR JOURNALS WITH SUPERFINISH

### . . . Low cost attachments eliminate grinding, provide better surfaces in less time . . .

Looking for ways to reduce finishing costs? These setups, at Westinghouse Steam Division, Lester Plant, South Philadelphia, Pa., show how you can do it with Superfinish.

Here, low-cost Superfinish Attachments are used for journals on large, medium and small turbine rotors. The attachments are portable with adapter plates that permit mounting on the tool post of any lathe. The rotors are held between centers. Longitudinal feed is provided by the tool post carriage.

Previously, rotor journals were turned .030" oversize and ground. The best finish obtainable was 15 to 20 micro-inches RMS. Now, journals are turned .003"-.005" oversize, then Superfinished to 5 micro-inches RMS.

Savings? Grinding of large journals used to take 8 hours . . . Superfinish takes only 1 hour. The Superfinish Attachments handle new rotors and also refinish other journals damaged in service without having to return the spindles to the factory. Cost analysis showed that one attachment in the Small Turbine Department saved $644 a year on labor costs alone . . . a 30.4% return on the original investment!

***Superfinish saves time, provides better surface. Eliminates peaks...leaves plateaus and valleys for greater bearing area. Corrects part geometry...does not change surface hardness ...assures longer service life.***

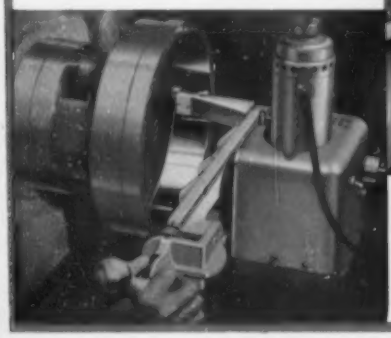
***For information on Superfinish, circle No. 755 on inquiry card.***

## MORE JOBS

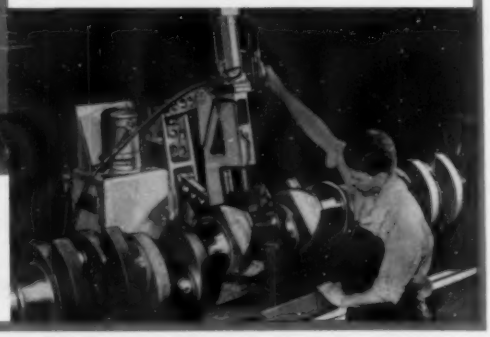
***. . . Proof that Gisholt MASTERLINE Superfinishing Attachments can be used to advantage in your own operations.***

Off-set stoneholders are used for straight or tapered internal work. Model 60 Attachment Superfinishes air cylinder bore in only 3½ minutes. Ground surface is reduced from 30 to 5 micro-inches RMS.

Previously, main, pin and journal bearings were chrome plated .015" oversize before finish grinding. Model 73 Attachment with latch-on follower-arm handles all surfaces. Superfinish required chrome plating only .002" oversize saving $15 per surface on chrome plating alone!



Mounted on a grinder, Model 62 Attachment combines operations on pump piston rods. Parts are ground to size, the grinding wheel retracted and the attachment used to expose true base metal and provide a smoother, 5 micro-inch RMS finish.



**GISHOLT**

MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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**Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products**

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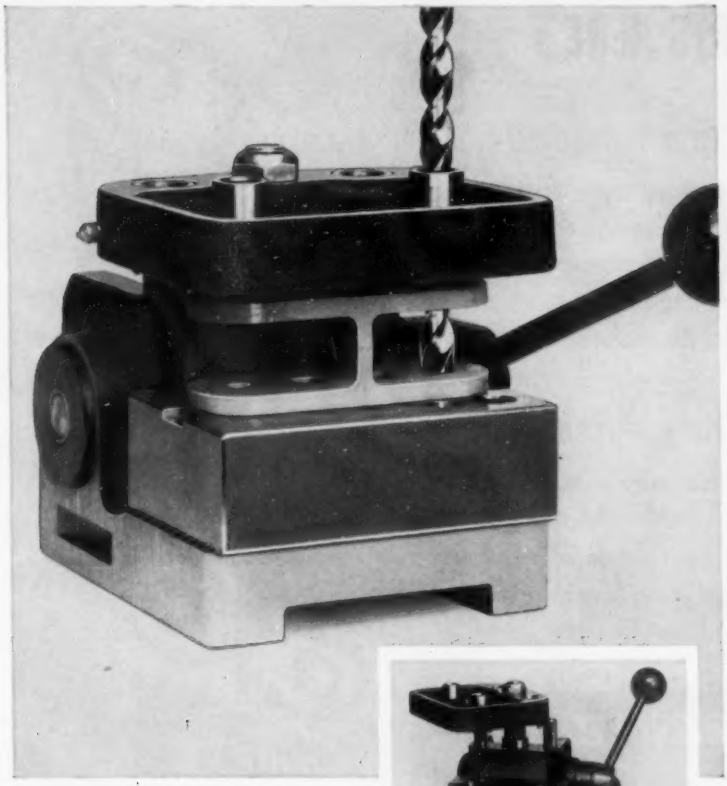
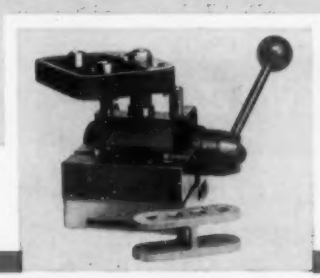
*Another production time-saver from Ex-Cell-O . . .*





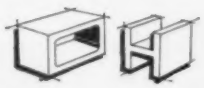
# LIFT-SWING: the answer to tough drilling jobs!

Available in a range of sizes for short-run and volume drilling, reaming and tapping, Ex-Cell-O's new Lift-Swing Drilling Fixture loads and unloads in seconds, and is precision-machined for 90° "tumble-jig" setups.

Patented "swing-away" top plates swivel for access to the part, and permit a variety of easily tooled jobs; double top plates let you drill stepped holes, or adjacent holes with minimum wall thickness, regardless of bushing wall size.

Your local Ex-Cell-O Representative or Distributor will gladly show you how low-cost Lift-Swing Drilling Fixtures save tooling time and fixture costs, or contact Ex-Cell-O direct for details: Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

**COMPONENTS FOR ALL YOUR JIG AND FIXTURE NEEDS— AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!**



**Micron Sections—** Machined cast-iron shapes cut to order.

**Drill Jig Bushings—** Carbide or steel for metal and plastic jigs.

**Fixture Components—** Clamp assemblies and fixture details.

Reader Service Card Number is for Lift Swing literature only. Request literature on above items separately.

61-50 BU

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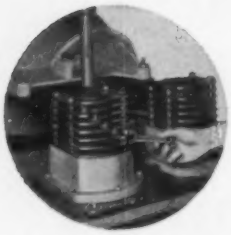
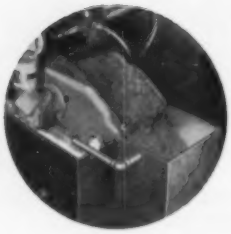
# QUALITY FOR YOUR PRODUCTS STARTS HERE



## ...WITH BARNESDRIL HONING MACHINES

Guarantee product quality through precision BarnesdriL Honing Machines. Greater ruggedness . . . a broader range of capacities . . . more compact design . . . easier maintenance — these are plus features inherent in every BarnesdriL machine to assure precision control at cost-cutting production rates. Our catalog 200 gives complete details. Write for your free copy!



## ...WITH BARNESDRIL FILTERS AND SEPARATORS

Control finish quality easily, more economically with BarnesdriL Filters, Separators, and Combination Filter-Separators. Designed to provide an abundant supply of clean, grit-free coolant, these automatic sludge removal units extend wheel life up to 50% . . . speed honing, gear-shaving and similar operations . . . cut coolant costs up to 300%. Send for catalogs 100-A and 300-D.

BARNESDRIL HONING MACHINES

*Honing Machines/Production Units*
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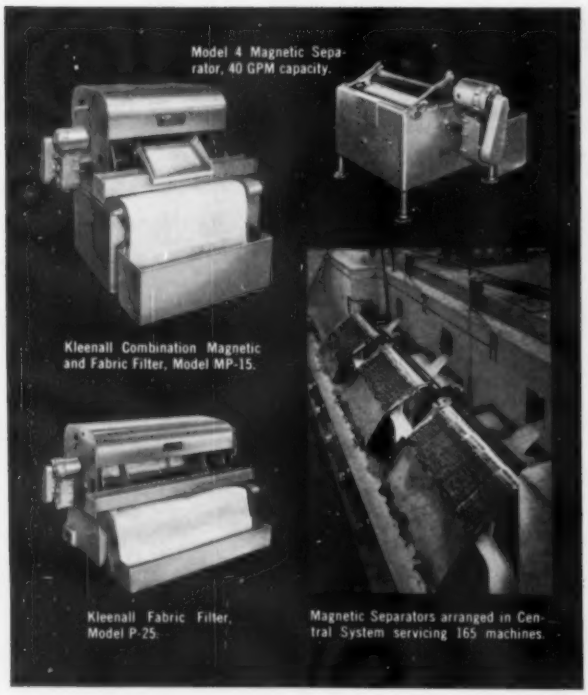
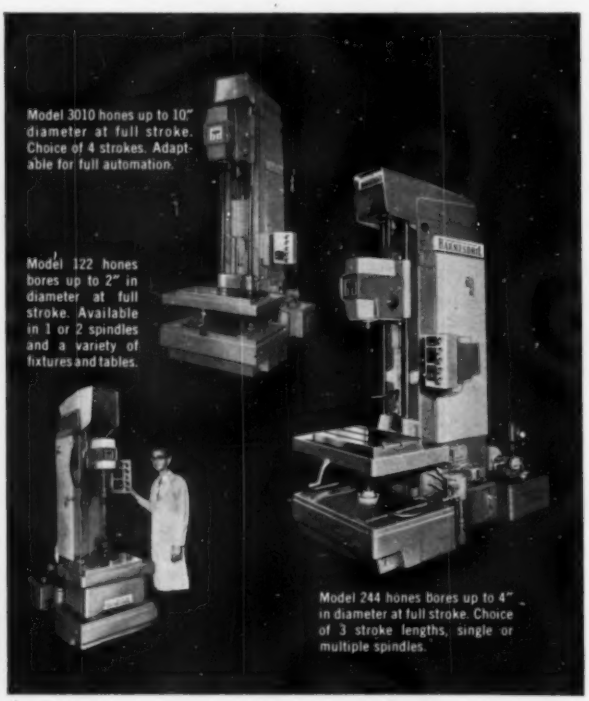
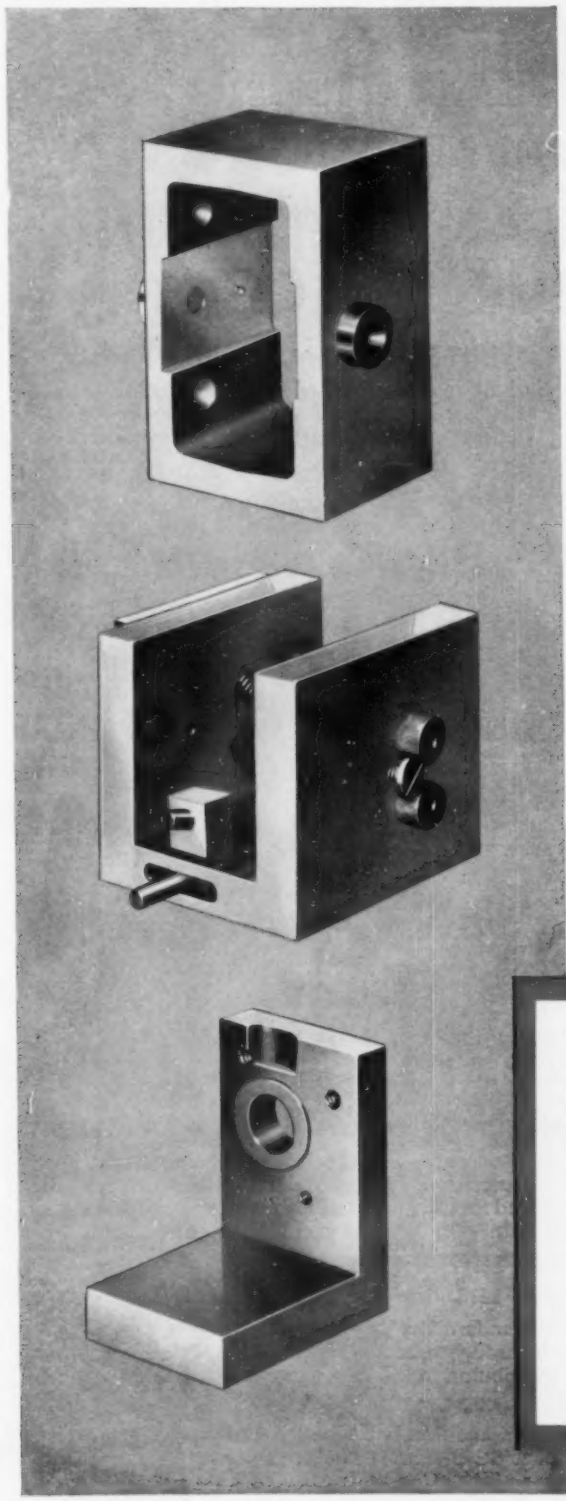

Model 4 Magnetic Separator, 40 GPM capacity.
Kleenall Combination Magnetic and Fabric Filter, Model MP-15.
Kleenall Fabric Filter, Model P-25.
Magnetic Separators arranged in Central System servicing 165 machines.


Model 3010 hones up to 10" diameter at full stroke. Choice of 4 strokes. Adaptable for full automation.
Model 122 hones bores up to 2" in diameter at full stroke. Available in 1 or 2 spindles and a variety of fixtures and tables.
Model 244 hones bores up to 4" in diameter at full stroke. Choice of 3 stroke lengths, single or multiple spindles.



# Build Fixtures Faster, at Lower Cost with Ex-Cell-O Micron Sections!

Available for immediate shipment, Ex-Cell-O Micron Sections are pre-machined square and parallel from high tensile strength cast iron to save you design and fabrication time.

Ideal for job-lot tooling, Micron Sections are cut to order from standard 25" lengths. Wall thicknesses range from ⅝" to 1¼", with overall dimensions from 3" x 3" to 8" x 10".

Call your local Ex-Cell-O Representative or Distributor, or contact Ex-Cell-O direct. Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

**COMPONENTS FOR ALL YOUR JIG & FIXTURE NEEDS—AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!**

**Lift Swing Fixtures** for fast drilling of difficult holes.

**Fixture Components** Clamp Assemblies & Fixture Details.

**Drill Jig Bushings** Chrome alloy bearing steel • Tungsten carbide • Trans-Lok, Press-Lok for plastic jigs.

Reader Service Card Number is for Micron Sections Literature only. Request literature on above items separately.

61-19 BU

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Atrax

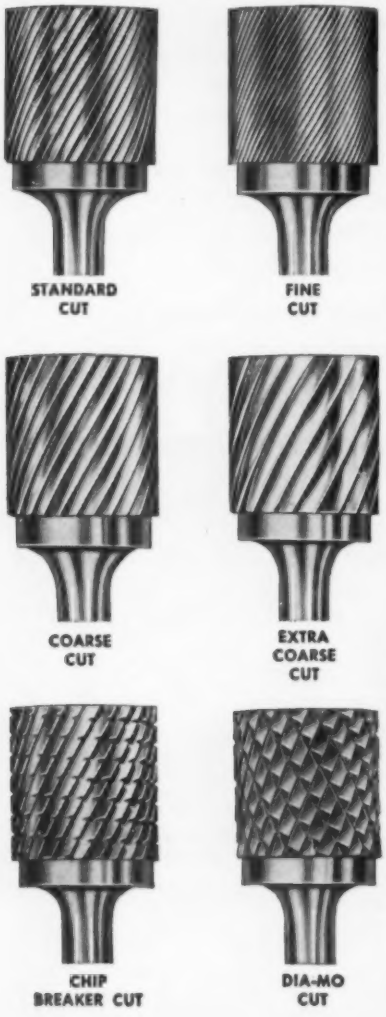
*Precision Ground*

# SOLID CARBIDE TOOLS AND BURS

# HOW TO BECOME AN EXPERT IN SOLID CARBIDE BUR SELECTION

Solid carbide burs are universal roughing and finishing tools. Atrax, manufacturing the most complete line, can furnish a size and shape to accomplish practically any metal removal or finishing operation.

## SIX BASIC CUTS




Applying the Chip Breaker or Dia-Mo cut to the other types offers 11 different available cutting combinations for each size and shape of bur.

## 14 DIFFERENT SHAPES

To make burs one of the most versatile of metalworking tools, 15 standard shapes—181 different sizes, each in the 6 cuts, make available a total of 1086 different burs for a large variety of metalworking requirements.

### PRODUCTION VERSATILITY

Atrax Burs, because of their controlled tool geometry and precision uniformity, are recommended for use on virtually all materials.

### BUR SELECTION AND SPEEDS

Bur selection depends on the operation and material to be cut. Bur speed also depends on these factors and on diameter of bur used.

### STANDARD BUR SETS

Atrax Solid Carbide Standard Bur Sets are also available through your dependable Atrax Distributor.

Complete engineering information on bur selection and use can be found on page 12 of the 148 page Atrax Catalog.

Be sure to send for your free copy today.

There is an Atrax Precision Ground Solid Carbide Tool engineered to every material and job application.

SEND FOR "STANDARD" REFERENCE ON SOLID CARBIDE TOOLS

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LEAD SCREW TAPPING UNIT

## Ex-Cell-O Hydraulic Power Units in Stock Now to Cut Your Machine Tool Lead Time and Production Costs!

Reduce lead time, increase productivity, and cut per-unit cost with Ex-Cell-O Quill-Type Hydraulic Power Units—immediately available for drilling, counterboring, spot-facing, and reaming operations, or as prime movers for milling equipment.

Ex-Cell-O Hydraulic Power Units are self-lubricated . . . built for easy installation, and trouble-free operation, even under fast cycles and continuous production. Compactness allows close center distance installation, in-line or radial . . . versatility makes them ideally suited for special-purpose, high production machines. A companion product, the Style 502 Tapping Unit, uses a lead screw for trouble-free tapping.

See your Ex-Cell-O representative or write direct for full information on the complete line of Hydraulic Power Units and our Canadian-built Lead Screw Tapping Unit.

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Machinery Division

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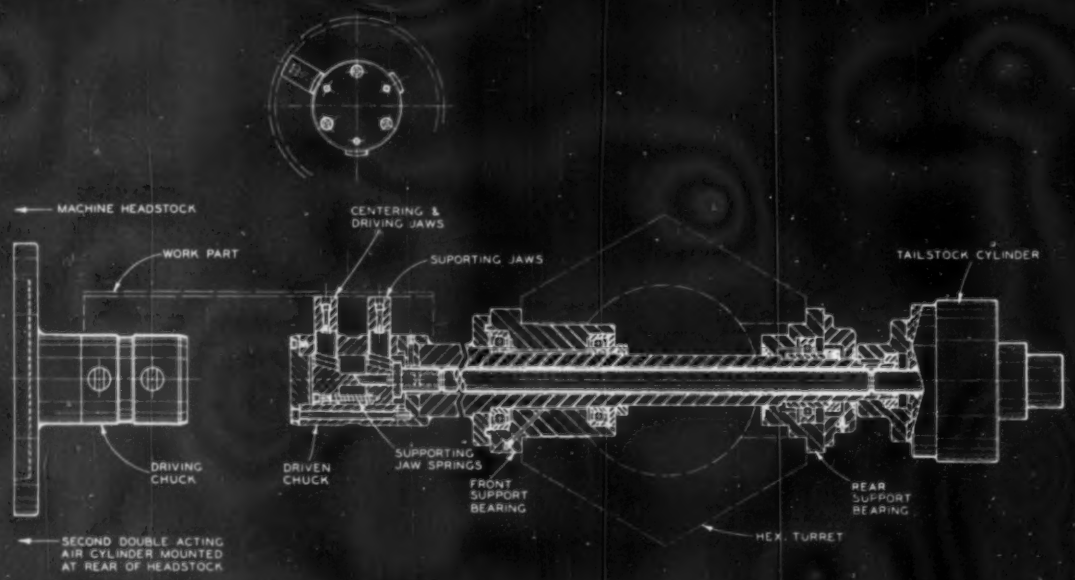
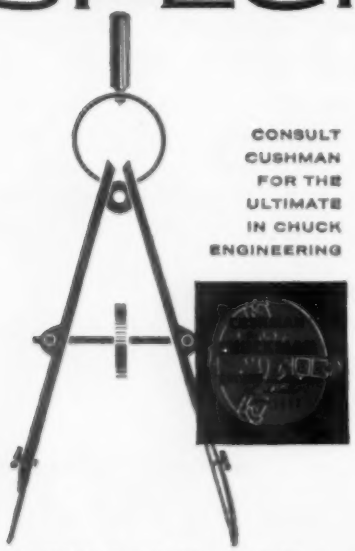
60-42

# SOLVE YOUR DIFFICULT WORKHOLDING PROBLEMS WITH




# SPECIAL CHUCKS



**CONSULT CUSHMAN FOR THE ULTIMATE IN CHUCK ENGINEERING**

The assembly print reproduced above is but one of many examples of special chucks designed and engineered to meet unusual workholding and machining requirements. Cushman Special Chucks are being used in many diverse industries enabling manufacturers to meet realistic production quotas, maintain close tolerances and achieve lowest cost on both short or long runs.

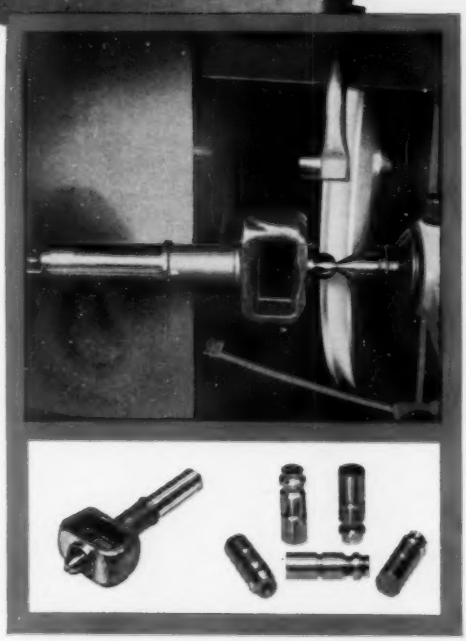
If you have a workholding problem, consult Cushman. Your problem may have already been solved.

**THE CUSHMAN CHUCK COMPANY · HARTFORD 2, CONNECTICUT**

*Manufacturers of Air and Manually Operated Chucks, Power Wrenches, and Face Plate Jaws.*

**Use Reader Service Card, CIRCLE 26**

# NOW—An Automatic Form and Groove Grinder . . . designed for tomorrow's production requirements!



**WORKPIECES**—Standard Ex-Cell-O Model 973 takes parts up to 24" long. Can be equipped for parts with 36" centers. Workhead adjustable for angular settings.

**OPERATIONS**—Precision-built for rough, semifinished or finished production grinding.

**CONTOURS**—Grinds straight, angular and radius grooves, and a variety of forms. Grinds multiple grooves when fitted with two or more wheels.

**CYCLING**—Fully automatic cycling, including opening and closing hood. Rapid wheel slide advance and return for maximum productivity.

**SIZE CONTROL**—Automatic wheel dressing after each cycle or any number of cycles. Automatic wheel size compensation after each dressing. (Handwheel graduated to .0002" for manual setting.)

**DRESSERS**—Designed for use with all standard Ex-Cell-O Diamond Dressers, or any special rotary diamond-set wheel dressers.

**ACCESSORIES**—Model 973 is a complete, versatile machine with extensive automatic features. However, it is designed to be easily equipped with automatic work loading and unloading devices, air operated chuck and tailstock and other accessories to meet your special requirements.

**DATA AVAILABLE**—Contact your local Ex-Cell-O Representative, or write direct for descriptive literature and engineering data.

61—25M

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Machinery Division

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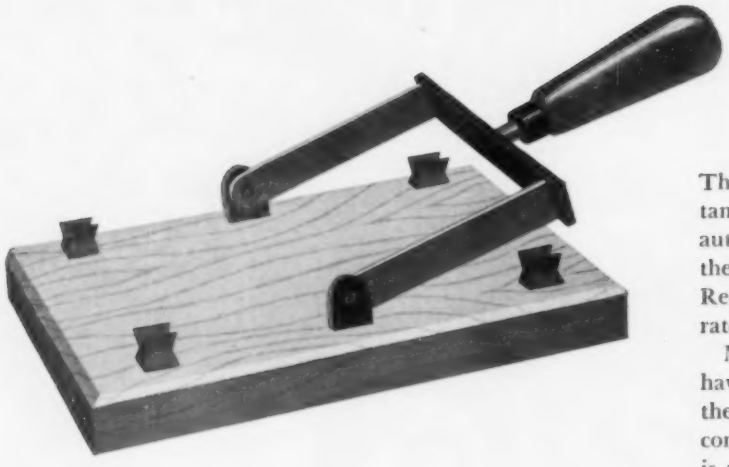
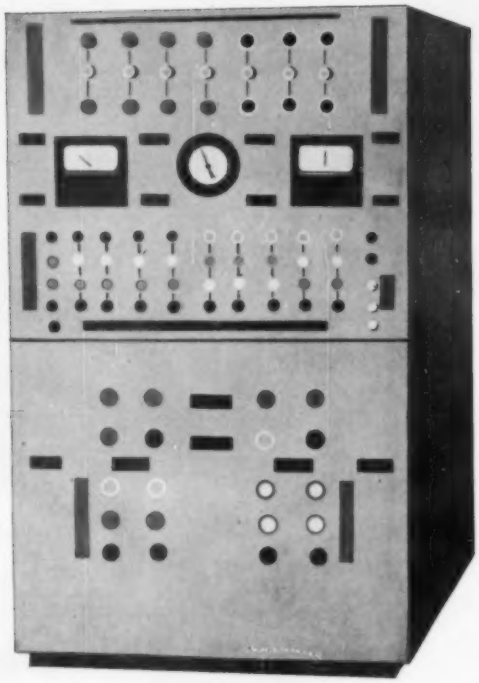


# REMEMBER?



The simple knife switch was important for many years. Today, foolproof automatic switchgear units simplify the control of electrical distribution. Results: more applications at lower rates.

Methods of control of electricity have stepped up considerably, from the simple switch, to today's closely controlled electrical transmission that is practically foolproof.

The extensive variety of electrical instruments with different mountings makes the manufacture of modern control panels and components almost a one-of-a-kind operation. Until the middle 30's, each panel was handmade and required some 8 to 24 hours for producing holes and openings. Since that time users of Wiedemann turret punch presses have produced these panels, still often one-of-a-kind, in one hour or less. Now the Wiedematic reduces this time to ten minutes or less.

This makes the "Wiedemann Method" a "must" for fabricators of electrical panels, electrical boxes, electronic chassis and panels and similar parts with many holes of various sizes.

ALL metal fabricators should investigate the 60% to 90% savings offered by the "Wiedemann Method". Write us today for details.

*From the versatile 150 ton R-15 down to the hand operated R-2, there's a Wiedemann for your short run piercing requirements.*

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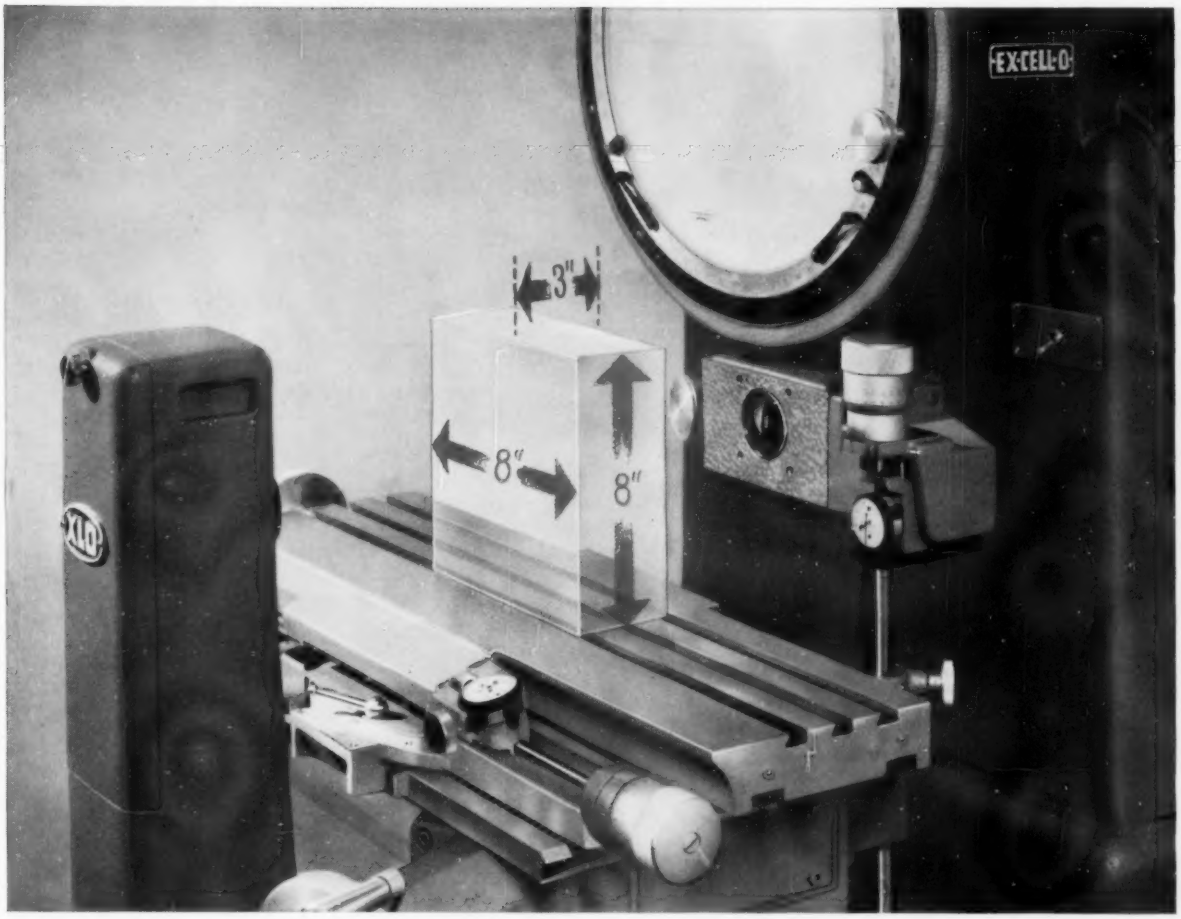


# EX-CELL-O Contour Projectors Give You 98% More Capacity

Ex-Cell-O Models 14-5 and 30 give you capacity to accept and optically gage much larger parts than is possible with other contour projectors,—*and without repositioning on the table!*

A full 8″ of table travel in both horizontal and vertical planes, together with 3″ of focusing travel is standard on these Ex-Cell-O Models. Every point within this "block" can easily be brought into focus on the screen.

Here is real capacity,—192 cubic inches,—98% *more* than the nearest standard model! Enables users to stage shafts 16″ in diameter, (and larger in some cases), and 16½″ in length on the standard work table with standard centers. Any point along the part contour can be optically gaged with convenient table movement.

"Cubage" isn't the only Ex-Cell-O capacity Plus! You get constant 8″ of working distance (lens to focal plane) —20% more than other standard projectors. Full 8″ of vertical measuring travel. Constant throat clearance, (collimator lens to front projection lens), of 17½″ on the Model 14-5; 16″ on the Model 30;—and Ex-Cell-O's rugged, heavy duty tables enable you to stage parts weighing up to several hundred pounds.

When you are ready to talk about Contour Projectors, compare feature for feature! There is an OGP Representative near you to demonstrate Ex-Cell-O's many PLUS values. Call or write. In the meantime, let us send you "43 Reasons Why EX-CELL-O Contour Projectors are the First Choice of Industry."

**You Can Purchase Ex-Cell-O Contour Projectors on Conventional Terms . . . Deferred Payment Plan . . . or Lease With or Without Purchase Option. Select the Plan Best Suited to Your Needs.**

Manufactured by EX-CELL-O Corporation at Detroit, Mich.

SOLD AND SERVICED BY

## OPTICAL GAGING PRODUCTS, INC.

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*(A subsidiary of EX-CELL-O Corporation)*



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Use Reader Service Card, CIRCLE 30

**All these ...and many more**

Whether your threading requirements cover miniature or very large tools, average or extremely close tolerances, run of the mill or space age components, short runs or long repetitive runs, somewhere in the GEOMETRIC line there is a tool for the job.

Precision operation, simplicity of design, interchangeability of chasers, high quality of materials and workmanship have made the name GEOMETRIC mean superlative tools.

- If you are not at present a user of **GEOMETRICS**, we invite your inquiries. If you are a user, we suggest further investigation of the broad line for other applications.
- For more information on the **COMPLETE GEOMETRIC** line, including range of sizes, special adaptations and styles not shown above, call your local GEOMETRIC Distributor, or write to

**GEOMETRIC TOOL CO.** NEW HAVEN 15 CONNECTICUT

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Eliminate Hazardous
Die Set Handling *with*

# SUPERIOR'S *Exclusive* safety flanges

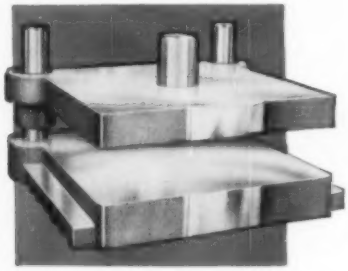
It is no longer necessary to take needless risks in handling die sets. Risks that might easily injure the hands of skilled die makers or ruin costly dies in process. Superior's exclusive safety flanges eliminate these hazards, by providing roomy gripping space on both sides of the die shoe, giving protection to the handler's fingers and hands.

This safe, secure gripping flange is one of the many exclusive features incorporated on Superior die sets, that safeguard against injury, to handlers, speed handling and lower overall die making costs.

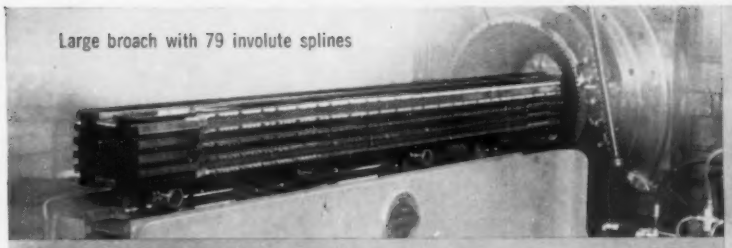
*Write today for our free 28 page catalog that gives complete information and specifications.*

SAFETY FLANGES MOUNTED ON ALL SUPERIOR DIE SETS AT NO ADDITIONAL COST.

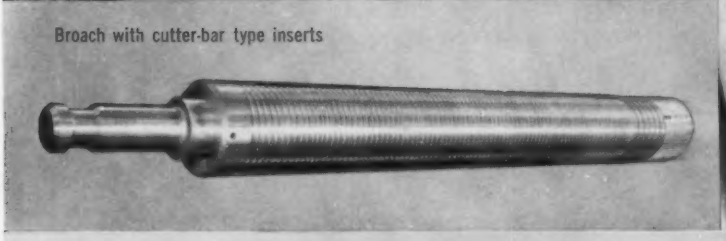
**On display Booth 3618 ASTME Exposition, May 22-26, New York Coliseum.**



**SUPERIOR DIE SET CORPORATION**
*2754 South 19th Street • Milwaukee, Wisconsin*
*Cheshire, Connecticut*



Large broach with 79 involute splines



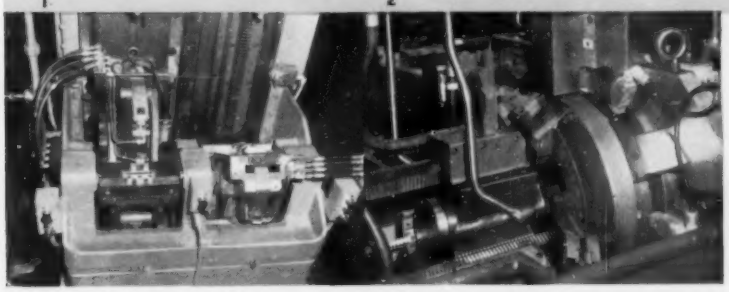
Broach with cutter-bar type inserts

Pot-type broach showing broached camera lens attachment

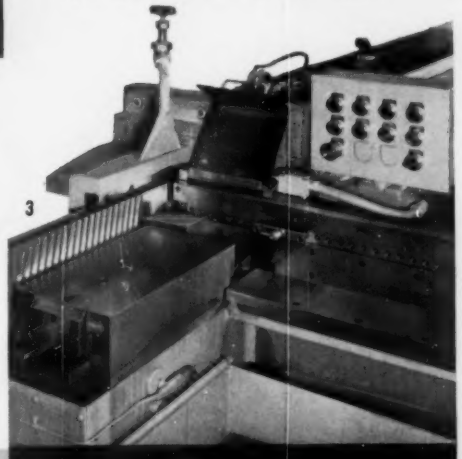
Say!...you forward-looking engineers who are investigating numerical control: **LAPOINTE**

# BROACHING TOOLS AND FIXTURES

have offered you the basic advantages of numerical control for nearly 60 years!



1. For surface broaching a compressor body, this work-holding fixture has hydraulically operated clamping mechanism.
2. Rotary type 3-station holding fixture, for broaching progressive internal cuts in the work piece, without handling.
3. Vise-type fixture, hydraulically operated, for squaring ends on work up to 6" square.



**Look at these striking cost-reduction features,** available to the metalworking industry through Lapointe-Broaching . . . the identical advantages claimed for numerical control: • Saves set-up time • Good for short runs • Can use inexperienced operators • Eliminates errors and production of scrap parts.

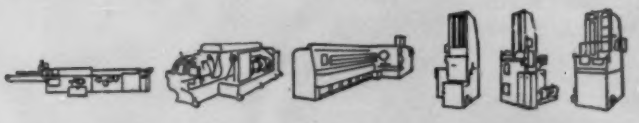
**By using Lapointe Broaching Tools and Fixtures** you get all the accuracy demanded by a difficult contour. You get close missile-type tolerances, fine finish. It's virtually "built-in numerical control" for the repetitive production of any simple or complicated part. (And it's far less costly, for equipment!)

**The greatest potential for cost reduction** exists in the field of Lapointe-Broaching. We earnestly suggest that you invite an experienced Lapointe Field Engineer to show you how to save money in your plant through the use of Lapointe-Broaching.

**THE LAPOINTE MACHINE TOOL COMPANY**

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



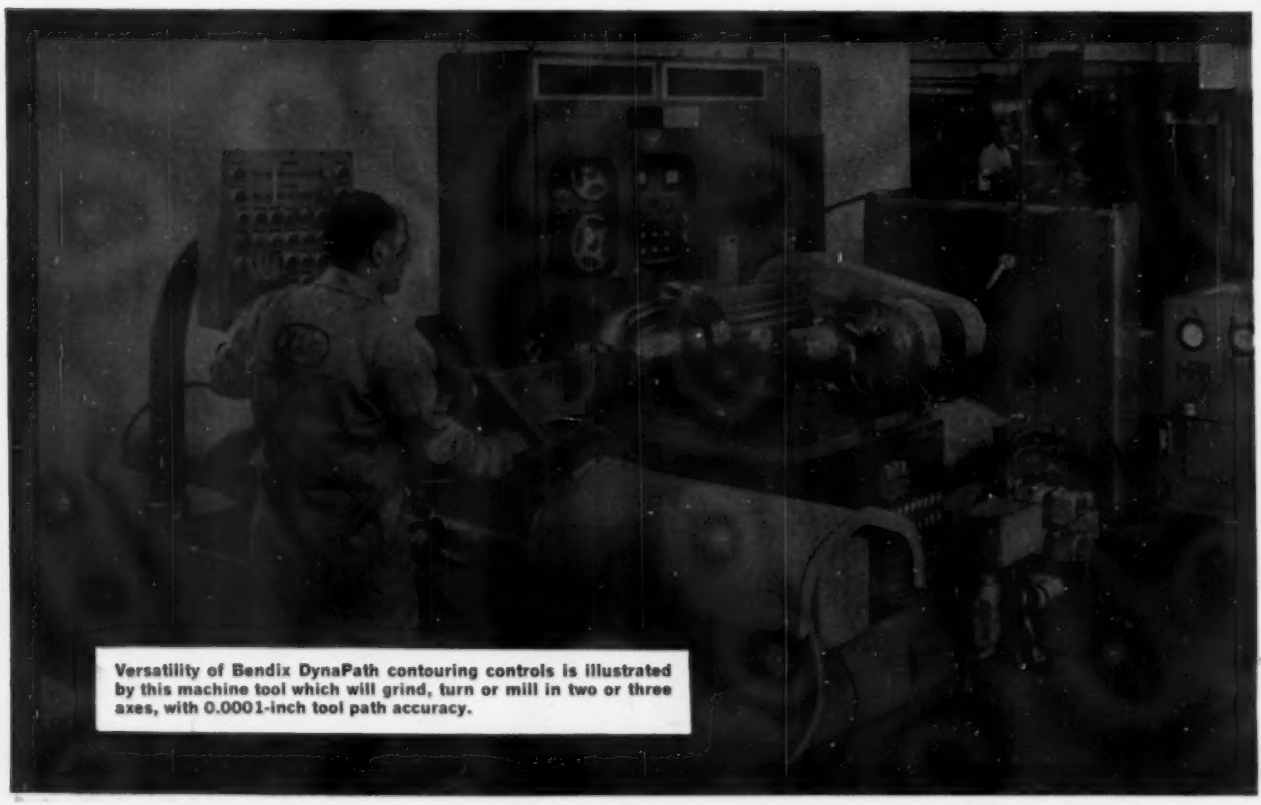
**LAPOINTE**

known to be the best in

**BROACHING**

# BENDIX PROVIDES SYSTEMS EXPERIENCE TO MAKE NUMERICAL CONTROL WORK FOR YOU

Numerical control is a proved concept in metalworking. It has demonstrated its worth in scores of applications, but perhaps your manufacturing problems are different. Why not enlist the services of Bendix—long-time supplier of practical, reliable numerical control systems to most major machine tool builders. Let us be your prime source of information and assistance when the demand for increased productivity indicates a need for more modern equipment that will reduce scrap, reduce lead time, reduce inventory costs, and reduce tooling costs. Whether it's contouring, positioning or measuring, Bendix has the solution to your particular problem.



**Versatility of Bendix DynaPath contouring controls is illustrated by this machine tool which will grind, turn or mill in two or three axes, with 0.0001-inch tool path accuracy.**

**YOU NEED BENDIX SYSTEMS EXPERIENCE** when you consider numerical control for your application! Bendix offers:

**1** **JUSTIFICATION STUDIES**—what can numerical control do for you?

**2** **SYSTEM ENGINEERING**—applying the right control to the right machine tool.

**3** **TRAINING AND SERVICE**—for maximum machine utilization rates.

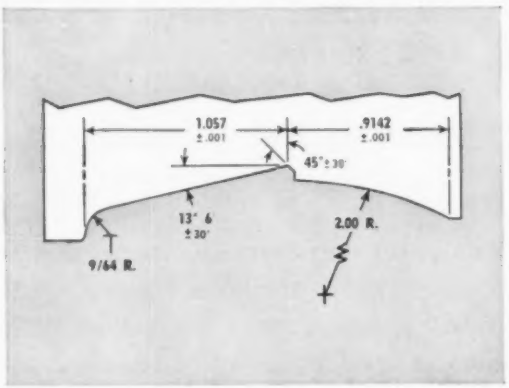
The unique Bendix Systems Experience is backed up by a staff of experienced electronic, mechanical and hydraulic engineers, mathematicians, instructors, technicians, and parts planners. Our contract machining and tape-making facilities offer years of accumulated case histories on all manner of applications *and* a chance to check out *your* problems in actual practice. Why not write today for more information on Bendix Systems Experience.

Industrial Controls Section
28120 Wyoming Ave., Detroit 37, Michigan

THE Bendix CORPORATION

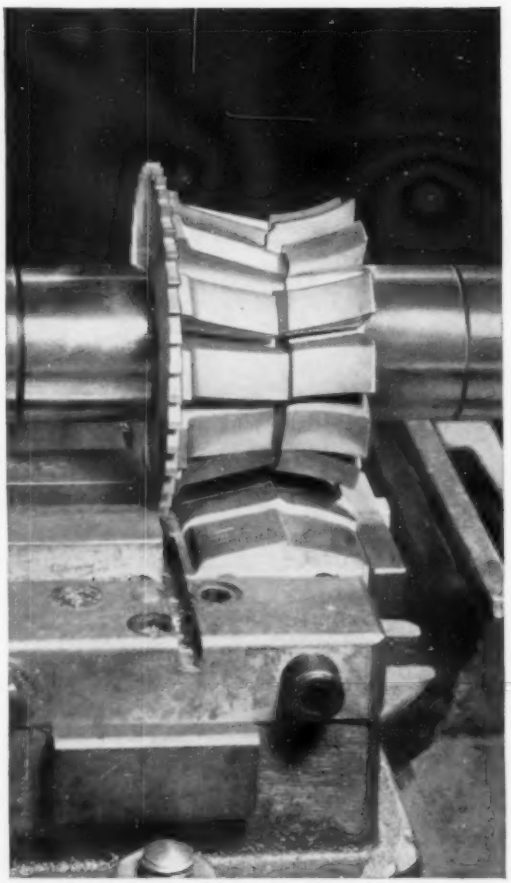
Bendix
SYSTEMS EXPERIENCE
For tool room work, Bendix DynaPoint positioning systems can hold 0.0001-inch tolerances on this jig borer.
With Ferranti numerical control, this turret drill will do the work of several conventional machines and reduce scrap.

# COMBINE

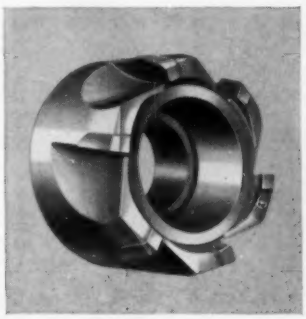



# OPE

How many FREE OPERATIONS can you see in the set-up illustrated below ? Not a fair question, but there are TWO. With the help of Barber-Colman cutter engineering, the customer was able to combine complex and very accurate milling in a single, economical operation.* There may be possibilities for savings like this in your plant. Perhaps special form cutters can be designed for SINGLE-SETUP MACHINING of parts you may now be shaping, crush grinding, or milling. A Barber-Colman cutter engineer can help you develop these opportunities. He is a fully qualified tool designer. He won't waste your time. Even more important, engineering and manufacturing facilities backing him up cannot be duplicated anywhere. For example, an electronic computer is used to establish correct tool geometry. This means you get more actual development man-hours per job. The right combination

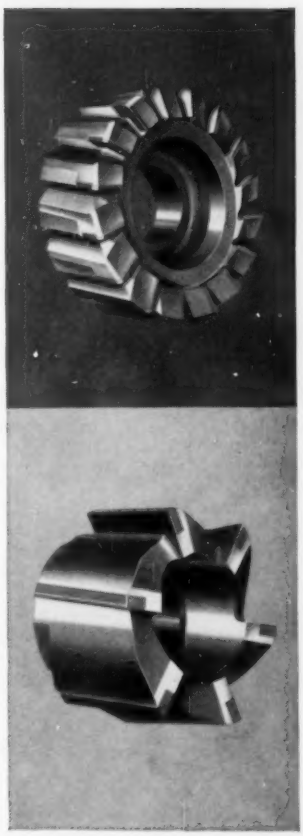


of flute helix, clearance angles, diameter, and number of teeth are determined scientifically—not by trial and error./The quality and depth of engineering talent available to you as a Barber-Colman customer can be worth many times the cost of tools. Early consultation on new parts can add to your engineering capacity. You get the benefit of proprietary innovations in metalcutting . . . in high-speed steel and carbide metallurgy, in tool design, and in manufacturing methods. Ask your Barber-Colman representative about this valuable free service.



# RATIONS

*Two opposed surfaces on the part shown (left) require machining at right angles to the cutter axis. For efficient milling at those points, teeth must have both left-hand and right-hand axial relief. The problem was solved by making the tool interlocking, with axial relief in both directions. Opposed helical flutes assure smooth cutting and excellent surface finish. A free cutoff operation was gained by ganging a metal-slitting saw with the form cutters. Cutters are unground. Yet, all dimensions are held to a maximum tolerance of ± .002 in. Angular surfaces are held to ± 30 minutes.



BARBER COLMAN

*BARBER-COLMAN COMPANY*

512 LOOMIS STREET, ROCKFORD, ILLINOIS

NEW . . . . . .

MODEL 136B-2

# . . MASTER COMPARATOR

The best thing about this high-precision electronic Comparator is its accuracy and operating convenience. The next best thing is its amazingly modest price*!

The Model 136B-2 measures any master ring from .040″ to 4.760″ and any master disc up to 3.500″ with repetitive accuracy to within two millionths of an inch! It measures with constant force, frictionless response, requires no warm-up.

This Horizontal Master Comparator is in a class by itself. It is one of the very few having the inherent design capability of **properly** and **reliably** checking Class XX masters, yet is far lower in price than **any** other high precision master comparator.

This is only part of the story. Send for full details.

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# NEW

# KENDEX* Profiling Tool

**See this new KENDEX Profiling Tool at Tool Show in New York Booth 2445**

## ...positively locked insert plus an adjustable chipbreaker

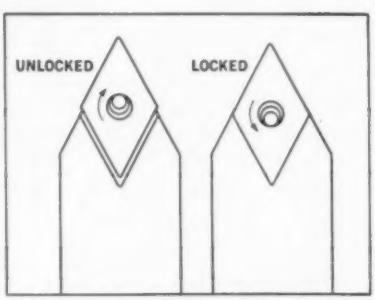
Now in one profiling tool you can get *both* of the latest design improvements. Another "first" from Kennametal Inc., the new Kendex Profiling Tool (A) securely holds inserts during normal cutting, back facing or contouring, and (B) permits a wide range of chipbreaker adjustment by simply turning a dial wheel.

The main design feature of this dramatically new Kendex tool is the eccentric pin that holds the insert securely in place. Positioned through a hole in the insert, this pin, plus the top clamp, positively eliminates any movement of the insert.

Just by turning the threaded dial wheel, the "Dial-A-Breaker" provides a wide range of adjustment of chipbreaker land width. Still another feature is the spring plunger that raises the chipbreaker when the clamp is released, making it easier to change, index or invert the insert.

Performance-proved on job after job over a period of months, the new Kendex Profiling Tool is now available from stock in three holder styles. The diamond shaped insert has a 55° nose angle, suitable for practically any profiling job. It is set in the holder at 5° negative side and back rake to provide four accurately indexable cutting points.

Get the complete story on this new profiling tool. Call your Kennametal Representative or write direct to KENNAMETAL INC., Latrobe, Penna.




As the wrench is turned it first rotates the eccentric pin, forcing the insert back and locking it against two walls of the recess. Further rotation of the wrench locks the eccentric pin so that it cannot loosen during use.

*Trademark

33599

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Use Reader Service Card, CIRCLE 40

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# VALLEY FORGE-1961

Nearly 200 years ago, at Valley Forge, we faced disaster. We face it again today, all over the globe, in our fight for industrial survival. Instead of watching competition both from here and abroad invade our established markets—and win the new ones to come . . . instead of waiting for better depreciation laws, we must fight back—now! Money invested in new machine tools—as precise and productive as only Pratt & Whitney can make them—is the first step in annihilating our enemy... obsolescence! We **didn't** surrender at Valley Forge. Will we surrender today? We **can't!** We **won't!**

Pratt & Whitney

HEADQUARTERS FOR AMERICA'S WAR AGAINST OBSOLESCENCE

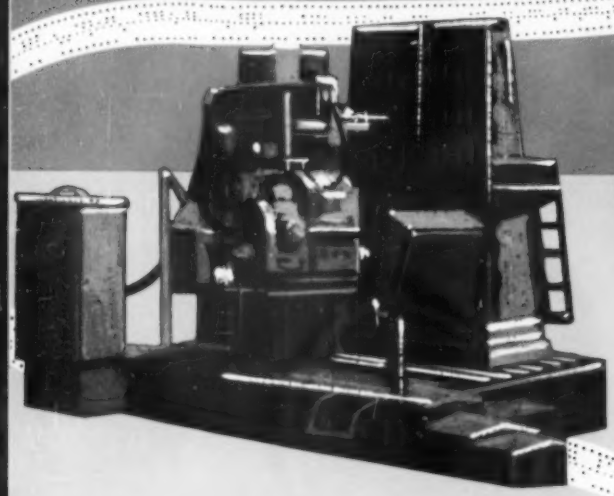
machine tools / cutting tools / gages

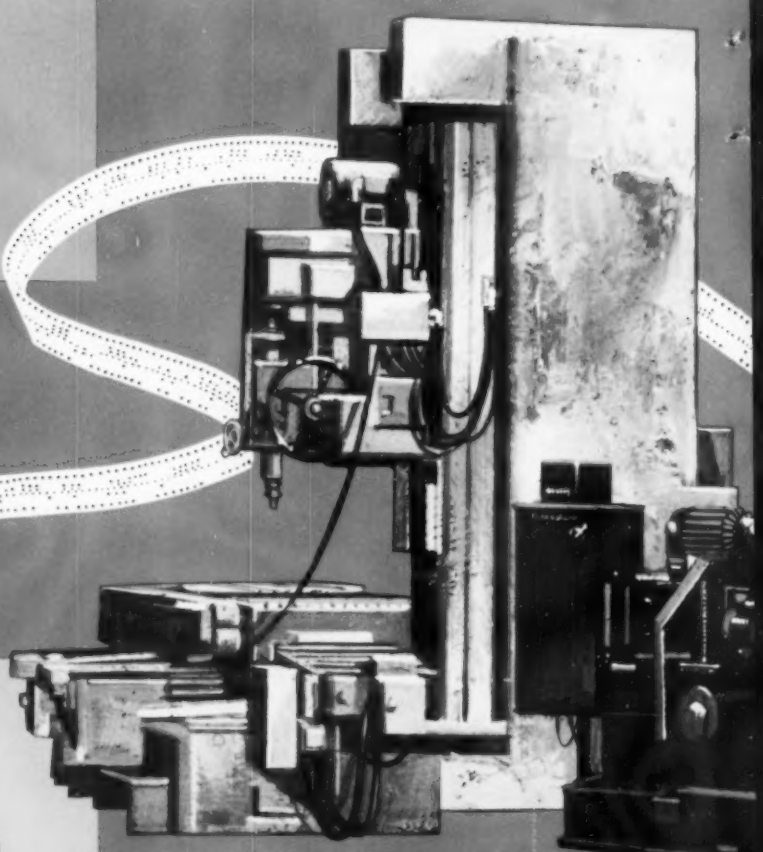
# WE HAVE THE TOOLS AND TERMS YOU NEED TO WIN YOUR WAR-NOW!

KELLER®

AUTOMATIC PROFILE MILLING MACHINES

Pratt & Whitney manufactures the world-famous Keller® Automatic Mill designed for continuous path or profile milling. Available in a wide range of models with either tracer or taped controls to speed up production and eliminate work spoilage.





*Electrolimit*® JIG BORERS

Industry's finest! P&W's Electrolimit® Jig Borers feature exclusives for unequalled versatility and accuracy. A complete line—from a model for precision machining of small jobs—to the biggest capacity jig borer built! Available with manual or taped controls which will insure top quality, eliminate work spoilage and increase production.

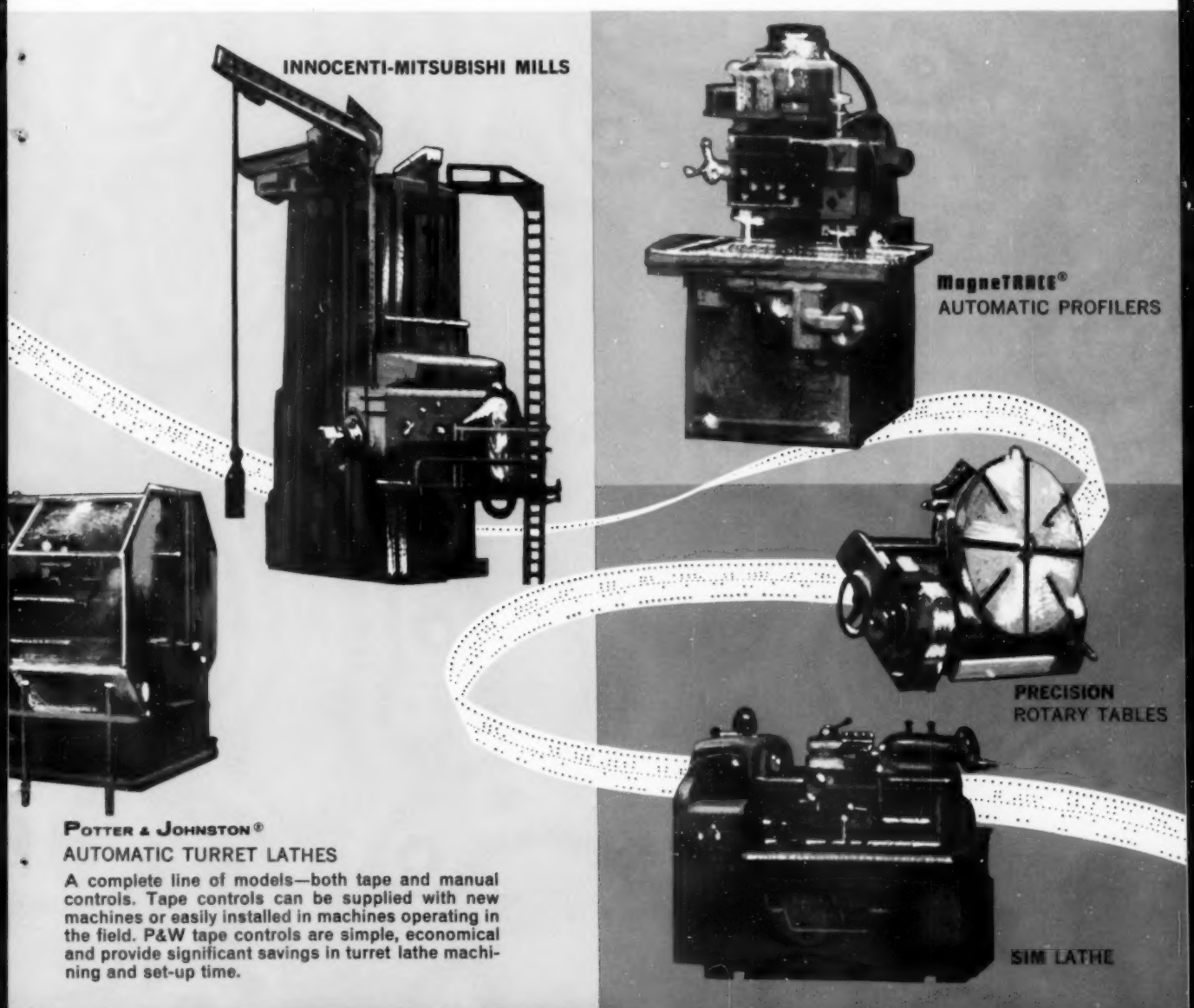
To wait is to surrender in your war against obsolescence! If your machine tools are not up to famous Pratt & Whitney caliber—obsolescence is eating up your profits—injuring your products! Pratt & Whitney Machine Tools are the best you can buy because our 100 years experience has taught us how to make them better. We believe the efficiency, quality, and precision of our Machine Tools are the answers to those with "wait-and-see" attitudes about more lenient depreciation laws!

Many of our Machine Tools are designed to bring the magic of tape-controlled automation to your production lines. All are available on terms that include lease, trade-ins, or options-to-buy. Our services are unparalleled in the industry! See for yourself: visit our Centennial Hall in West Hartford, Connecticut, where you'll find a complete up-to-date working display of Pratt & Whitney Machine Tools and a staff of experts ready to help you solve your specific metalworking problems. You're welcome to come in anytime—and prove to yourself that Pratt & Whitney Machine Tools are your best buy today—for tomorrow!

# Pratt & Whitney

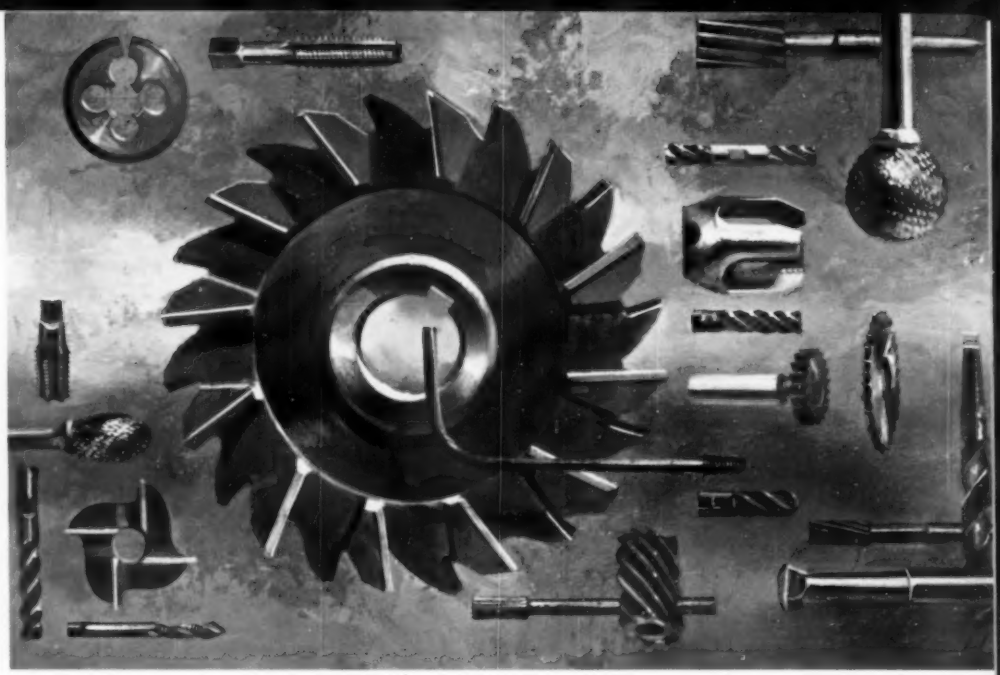
AMERICA'S HEADQUARTERS
FOR YOUR WAR AGAINST OBSOLESCENCE

JIG BORERS / ROTARY TABLES / KELLER MILLERS / MAGNETRACE PROFILERS / POTTER & JOHNSON LATHES




**POTTER & JOHNSTON®**
AUTOMATIC TURRET LATHES

**A complete line of models—both tape and manual controls. Tape controls can be supplied with new machines or easily installed in machines operating in the field. P&W tape controls are simple, economical and provide significant savings in turret lathe machining and set-up time.**



P&W's recently inaugurated policy of making P&W Cutting Tools and Conventional Gages available through factory-trained and selected Industrial Distributors makes personalized local service available to you . . . to simplify purchasing and speed delivery from local stocks.

P&W Cutting Tools include: Drills . . . Taps . . . Dies . . . Milling Cutters . . . Reamers . . . Burs, End Mills . . . in HSS and solid carbides.

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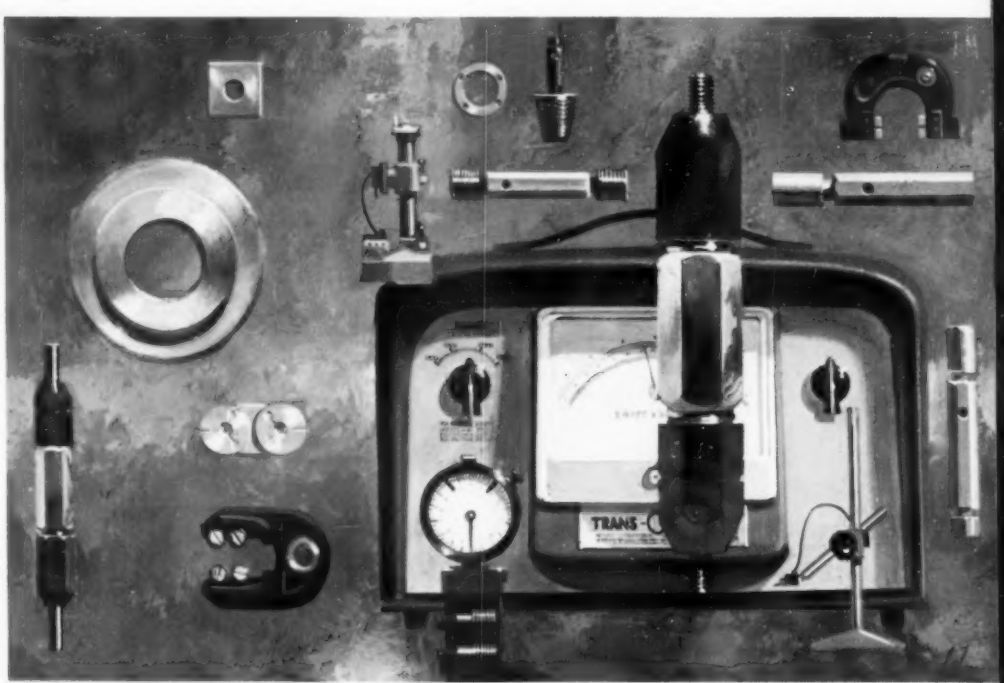

MACHINE TOOLS—CUTTING TOOLS—GAGES • HEADQUARTERS FOR AMERICA'S WAR AGAINST OBSOLESCENCE

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# DESIGN BARRIER

## by adding world's first

# SQUARE BARREL

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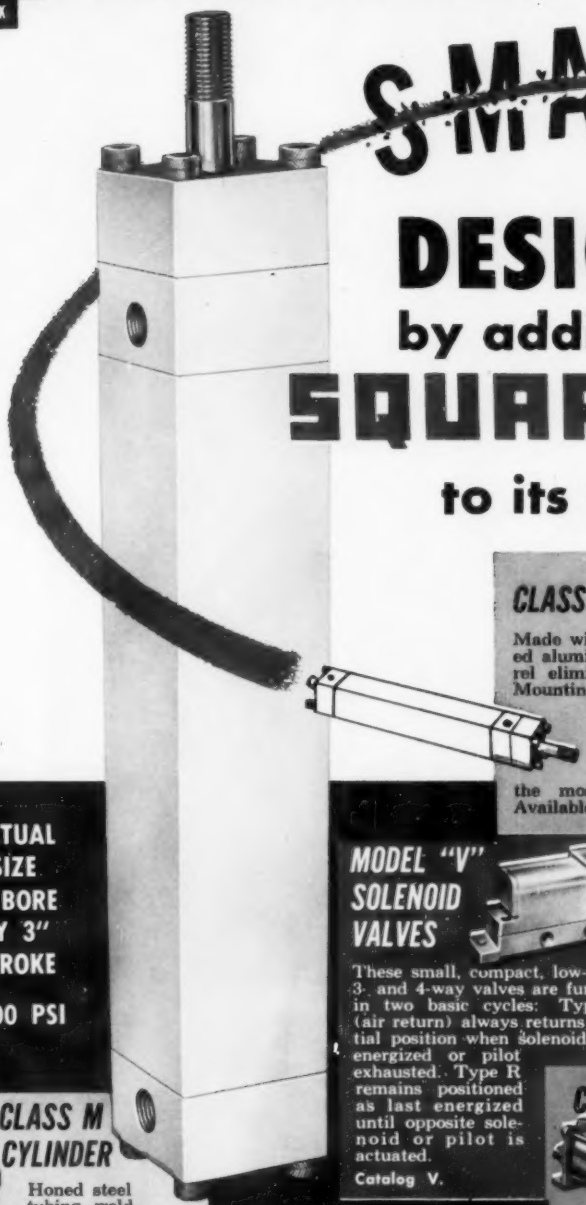


ACTUAL SIZE
1" BORE BY 3" STROKE
1000 PSI

### CLASS 7 CYLINDERS

Made with pressure cast and extruded aluminum. Square head and barrel eliminate the need for tie-rods. Mounting holes can be drilled or tapped directly into cylinder tubing. Cylinders in ¾", 1", 1½" and 2" bores are pressure rated for 200 psi air or 1000 psi oil in the most popular stroke lengths. Available in 7 universal mountings.

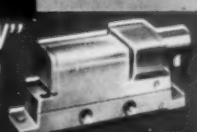
**Write for Catalog 107.**

### CLASS 3 & 6 CYLINDERS

**Class 3:** a compact, steel plate, square-head cylinder with tie-rod and honed steel tubing construction. Working pressures to 3000 psi. **Class 6:** similar in construction to Class 3, but for air pressures to 250 psi; hydraulic to 1500 psi. Square head design permits interchangeable mounting dimensions. Meet or exceed JIC requirements. Available in 18 standard mountings.

**Write for Catalog 103 or 106.**

### MODEL "V" SOLENOID VALVES



These small, compact, low-priced, 3- and 4-way valves are furnished in two basic cycles: Type AR (air return) always returns to initial position when solenoid is de-energized or pilot exhausted. Type R remains positioned as last energized until opposite solenoid or pilot is actuated.

**Catalog V.**

### CLASS M CYLINDER

Honed steel tubing, welded flange construction eliminates tie-rods. For all types of heavy duty air or hydraulic applications at pressures up to 650 psi. Available in 6 standard mountings.

**Write for Catalog 101A.**

### CLASS 1 & 2 CYLINDERS

**Class 1:** for pressures to 250 psi. Choice of adjustable cushion, self-regulating or non-cushion heads. Diameters from 1½" to 16". **Class 2:** similar to Class 1, but cylinder wall is recessed and gasketed into iron alloy cylinder heads. For pressures to 500 psi — air, oil or water. Available in 6 standard mountings.

**Write for Catalog 101A.**

### NOPAK-MATIC VALVES

Fast acting, high volume air valves in pipe sizes from ¼" to 1¼" with master (air piloted) single or double solenoid. Removing cover plates affords easy access to piston poppets housed within removable, interchangeable cartridges. 100% J.I.C. Easily modified for vacuum operation.

**Write for Catalog 105.**

### ROTATING DISC VALVES

The original NOPAK Valves, available in 2-, 3-, 4-way, and many special cycles for control of cylinders to 500 psi air or hydraulic. Precision lapped rotating disc and body seat are always protected from pressure flow or exhaust.

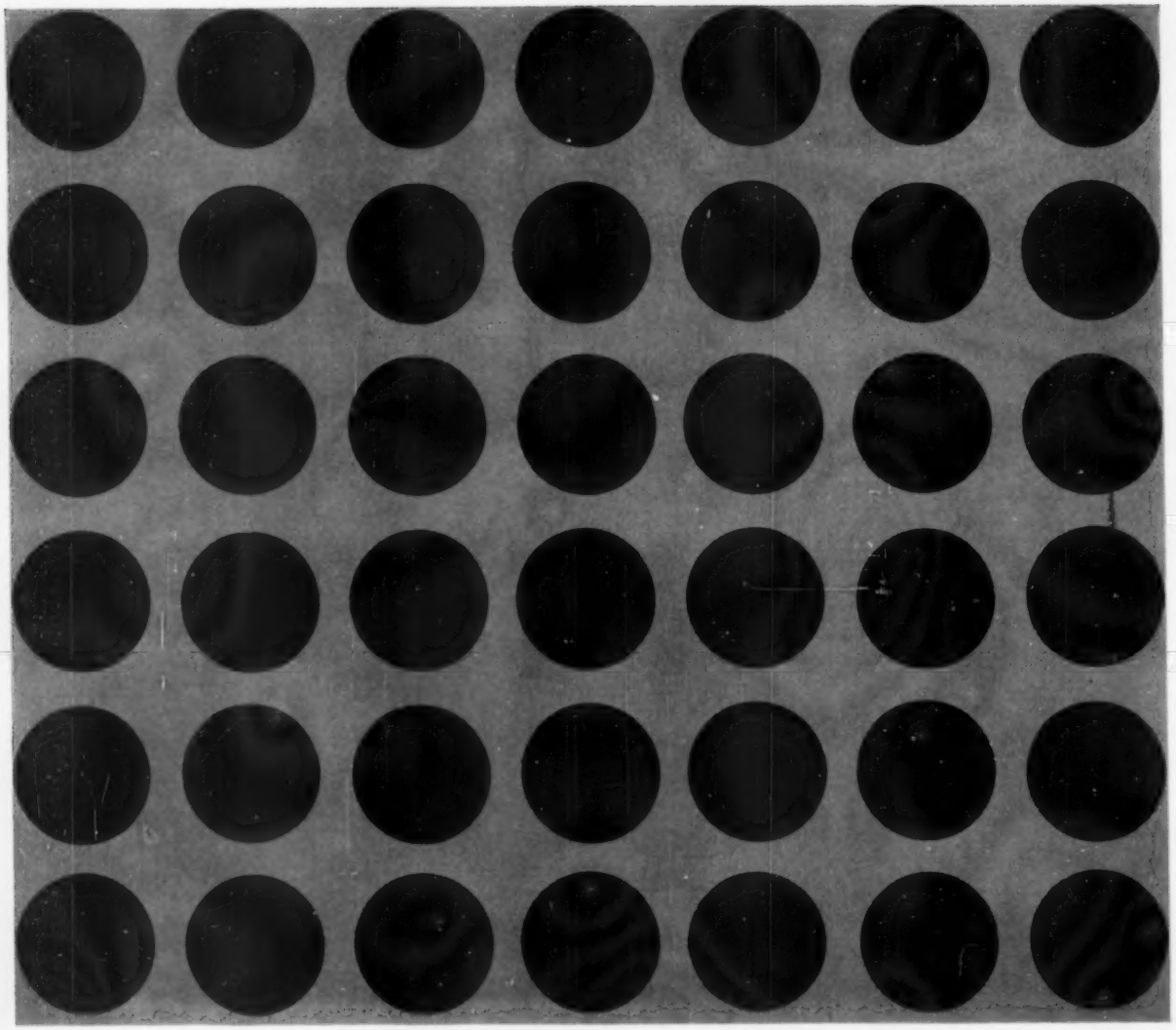
**Write for Catalog 102A.**

* C V A — CYLINDERS VALVES ACCESSORIES

NOPAK offers a complete line of Matched Fluid Power Components.

**NOPAK**
VALVES & CYLINDERS

GALLAND-HENNING NOPAK DIVISION
2743 S. 31st Street
MILWAUKEE 46, WIS.



(Fit 3/16" Pin)

(Clear #8 Machine Screw)

(Clear 163-175 Stud)

(Clear #8 Tapping Screw)

(Clear 5/32" Rod)

(Fit 3/16" Rivet)

(Tapping Hole for #14-10 Screw in 19 and 20 gauge steel)

## Use one 3/16" P.U.P.S. to make holes for all these applications!

Doesn't it just make good sense to use one size punch to make one size hole regardless of the way the hole is to be used? If you're using many different size punches to make the same hole over and over, you need to ask your Dayton Perforators Distributor for the facts about sensible **P**roven **U**sage **P**unch **S**izes! For his name and illustrated literature, write Dayton Perforators, Inc., Dayton 4, Ohio.

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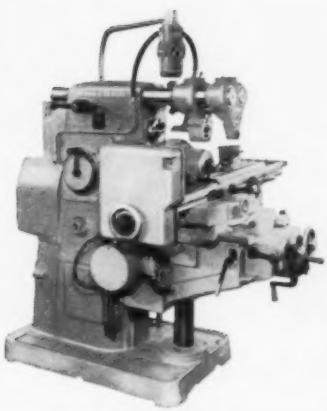
# 132

## cost-cutting combinations

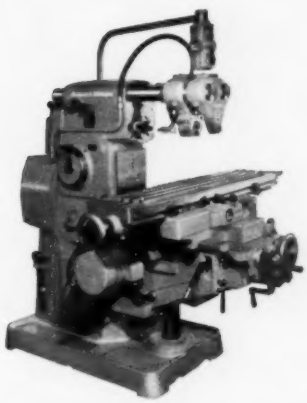
## The new Brown & Sharpe DYNAMASTER knee-type Milling Machines

### 3-5-7.5 and dual 10/5 hp

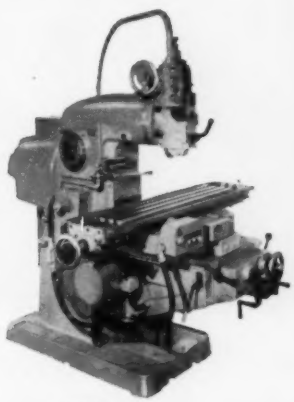
"Building block" design provides all wanted features — no more — no less — in "custom-built" combinations — at standard component costs



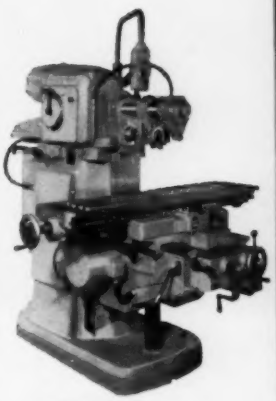
UNIVERSAL



PLAIN



VERTICAL



RANGEMASTER

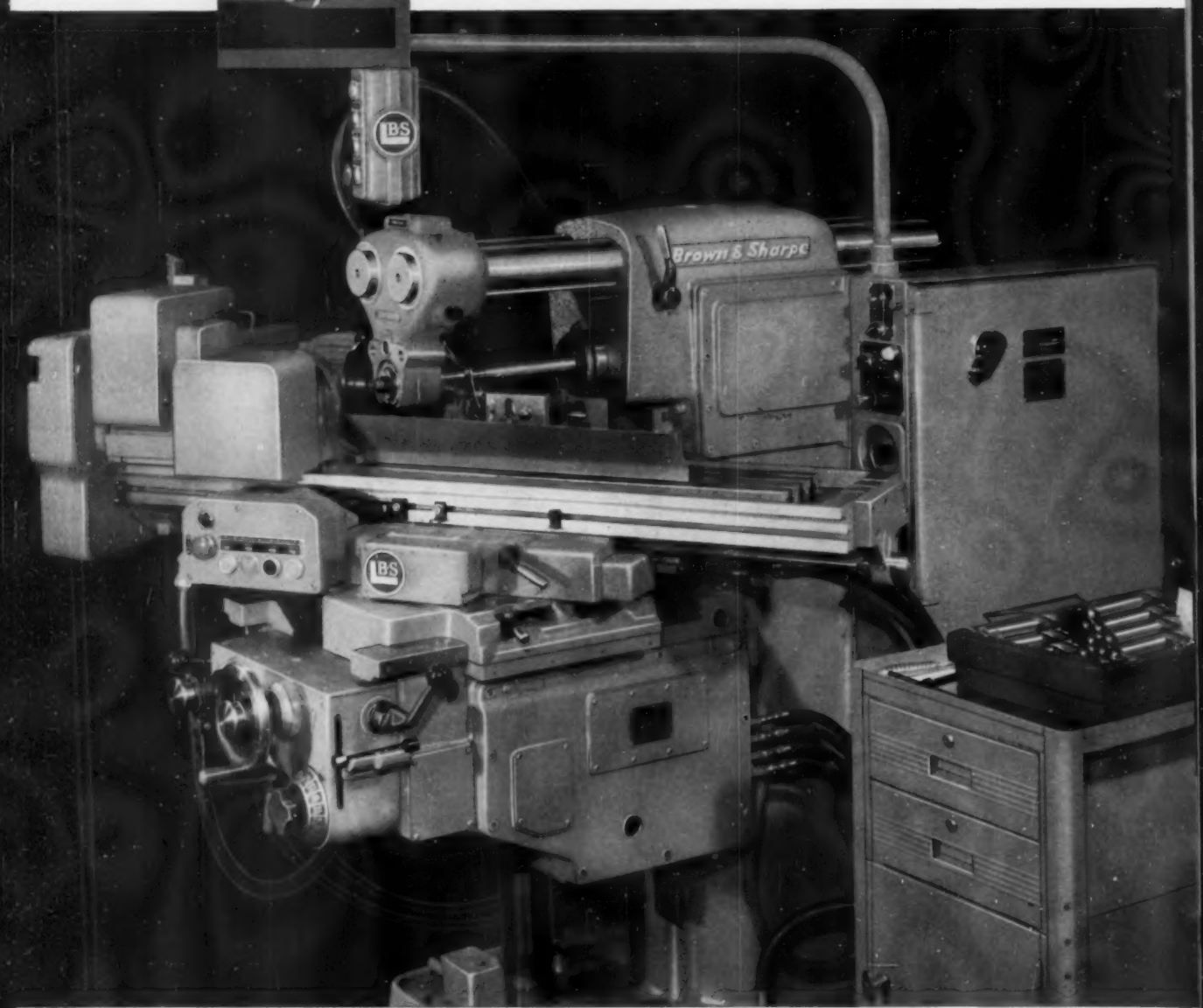
## to help you make more for less...

**Brown & Sharpe**

PRECISION CENTER

MMT·PE

TO HELP YOU MILL MORE FOR LESS




# New DYNAMASTER - only Universal with standard automatic cycle - saves cost of special machine

Work that requires a succession of helical milling cuts on parts produced in volume usually calls for a special automatic machine. Now you can get the same automatic production economy with the new Brown & Sharpe DYNAMASTER Universal, equipped with a standard automatic cycle arrangement, rise-and-fall knee positioning arrangement, and automatic indexing.

The standard "building block" construction of the new DYNAMASTER series permits you to buy a machine "custom-built" to your needs at the price of standard equipment.

Before you buy milling machines for toolroom, experimental work, repair department, or production, get the complete story of the 27 design improvements, with 9 cost-saving advantages available only in a DYNAMASTER. Universal, Plain, Vertical, and Rangemaster . . . 14 models. For details, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

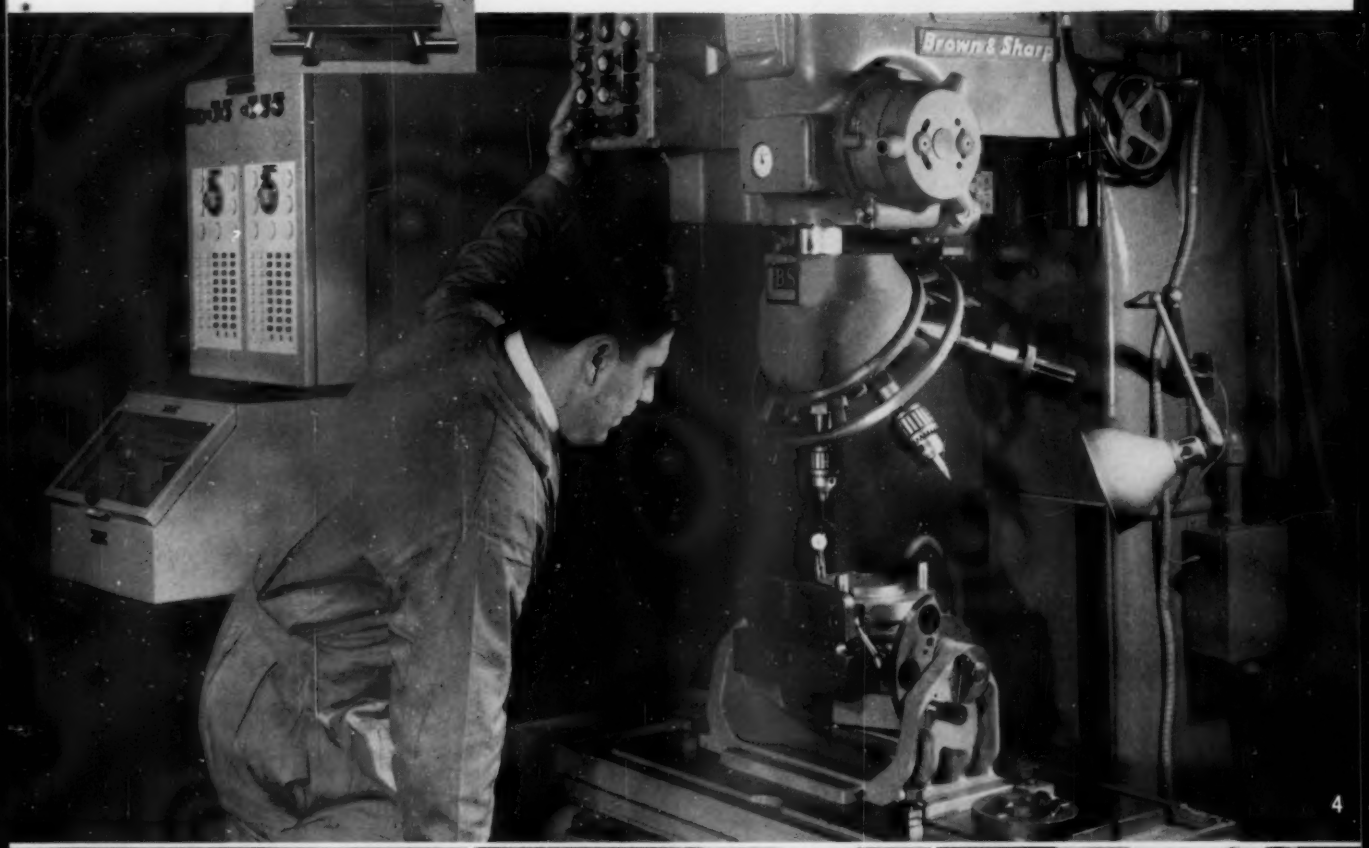
**THE AUTOMATIC MILLING CYCLE** is established by setting the table dogs. Operations are completely automatic, freeing operator after workpiece has been loaded and machine started. Machine stops automatically when all cuts are completed. Rise-and-fall knee positioning arrangement drops table 1" to provide clearance required during run back in helical milling. A special arrangement provides automatic indexing of the spiral head. A simple selector switch permits quick changeover from auto-indexing to manual control, when required, for short runs or special jobs.

**Brown & Sharpe** PRECISION CENTER

Use Reader Service Card, CIRCLE 48

MMT-PE

TO HELP YOU DRILL AND TAP MORE FOR LESS



# TURR-E-TAPE "simplimates" conversion to tape control—four easy steps start savings as high as 80%

Have you rejected tape control because you believe conversion is a complex procedure, requiring big investment in auxiliary equipment, and expensive, skilled personnel? If so, you have a welcome surprise ahead.

Four simple steps, and the TURR-E-TAPE, a tape-controlled Brown & Sharpe Model B Turret Drilling Machine, automatically performs a series of drilling, tapping, and boring operations in work moved automatically to hole locations on a B&S Positioning Table. Tooling costs can be virtually eliminated, and you also save on skilled labor costs and nonproductive time.

If your production requires numerous short runs of parts, or long runs of parts used a few at a time—find out how much you can save . . . and why, with the TURR-E-TAPE, conversion means "simplimation." For details, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

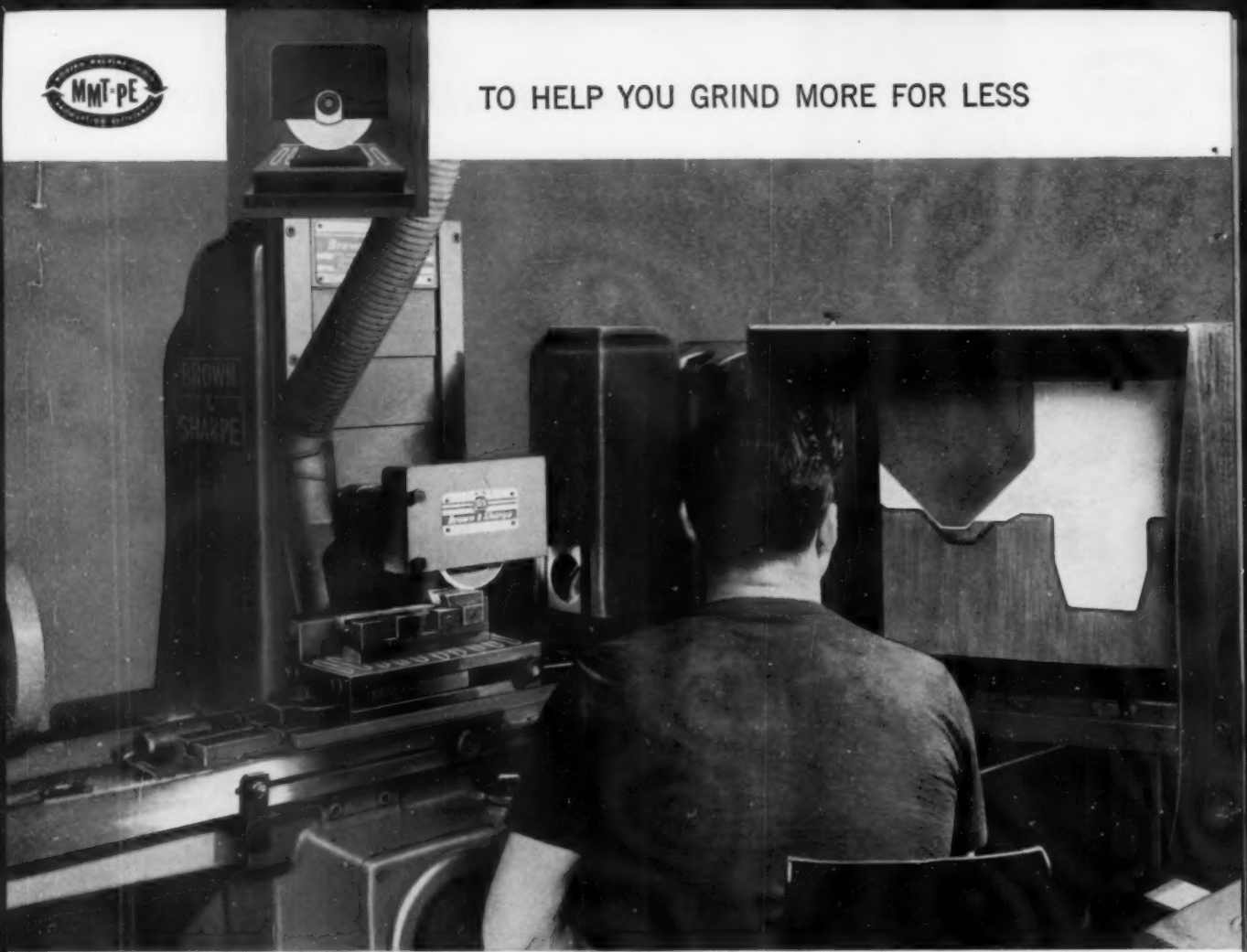
**You start with a drawing** (1) just as in conventional machining. Preparing the process sheet, step (2), requires no special skill. Tape preparation, step (3), is a commonplace assignment today. Step (4) requires only the proper location of work, with reference to table position. Four easy steps—then TURR-E-TAPE takes over, and you start saving. B&S Turret Drilling Specialists will analyze your operations and furnish a complete cost report at your request.

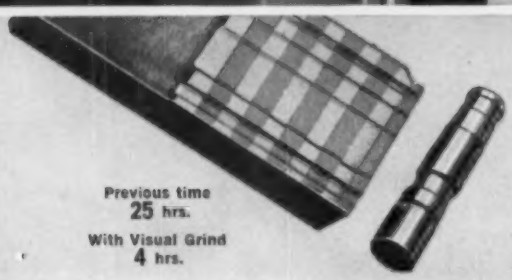
**Brown & Sharpe** PRECISION CENTER

Use Reader Service Card, CIRCLE 49

MMT-PE

TO HELP YOU GRIND MORE FOR LESS



Previous time **25** hrs.

With Visual Grind **4** hrs.

Carbide insert forming tools are ground with 5 microinch finish to provide specified 12 microinch finish on piece. Accurate grinding of blending radii in form was extremely difficult before — is now no problem with Visual Grind.

Previous time **20** hrs.

With Visual Grind **7½** hrs.

## Carbide forming tools ground 6 times faster with VISUAL GRIND... steel tools 4 times faster

Olson Mfg. Co., Worcester, Mass., makes screw machine products in large variety and volume. For reducing costs of the many forming tools required, Olson relies on the B&S MICROMASTER Surface Grinding Machine equipped with VISUAL GRIND. Time-saving over former method is up to 90% for carbide tools, and up to 75% for steel.

With VISUAL GRIND the comparator is built in. There is no time lost removing work for frequent inspection with separate equipment. The operator easily "follows the line," and matches the true image of the work to the form layout drawing mounted on the screen. Any contours can be reproduced with a few simple wheels — reducing wheel costs. Find out how much you can save on punches, dies, and similar forms — with through, blind, or template grinding. For details write: Machine Tool Div., Brown & Sharpe Mfg. Co., Prov. 1, R. I.

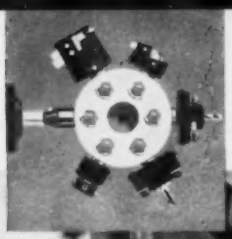
**The VISUAL GRIND®** optical system, manufactured by Cleveland Grinding Machine Co., is available only combined with the B&S 618 MICROMASTER. The complete "package" is sold and serviced by Brown & Sharpe. It can be used for other grinding of surfaces up to 6" x 12", without disturbing the optical system.

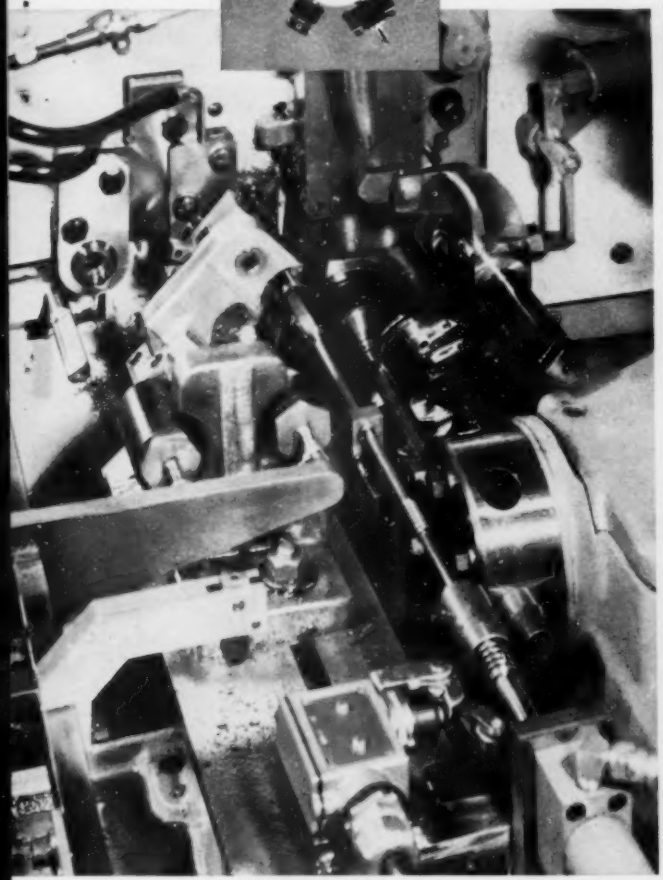
**Brown & Sharpe** PRECISION CENTER

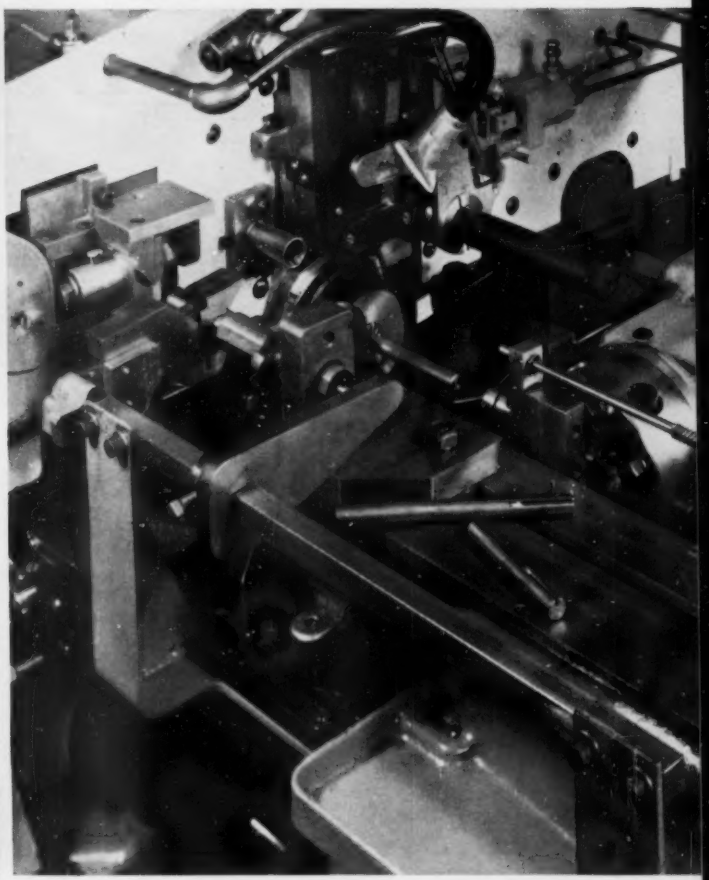
Use Reader Service Card, CIRCLE 50

MMT-PE

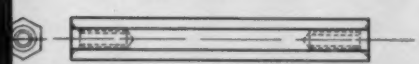
ASK ABOUT THE $500 TRADE-IN ALLOWANCE
ON OLD B&S AUTOMATIC SCREW MACHINES





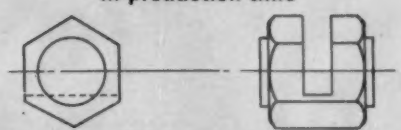


**90% SAVING**
**in production time**



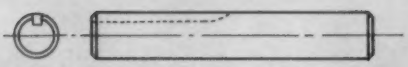
Cold drawn steel part now completed in one machining cycle on No. 2 Automatic with special Rear-end Drilling and Tapping attachment. Formerly, after blanking out on Automatic, second operation on hand machine was required to center, drill, and tap hole at back end.

**80% SAVING**
**in production time**



B-1110 steel part now completed in one machining cycle on No. 2 Automatic equipped with standard Cross Milling attachment. Formerly, after blanking out on Automatic, second operation was required to mill the slot.

**55% SAVING**
**in production time**



Cold rolled steel part now completed in one machining cycle on No. 2 Automatic equipped with special Keyway Milling attachment. Formerly, after blanking out on Automatic, second operation was required to mill the keyway.

## New attachments extend job range of B&S Automatics - eliminate second operations - reduce cost 50% or more

An unlimited variety of parts that require unusual slotting, milling, drilling, or tapping operations can now be completely machined from the bar on Brown & Sharpe Automatic Screw Machines. Many new attachments, standard and special, can be used to eliminate second operations.

Cost reductions as high as 90% are frequently obtained, and fewer machines are required. Along with these big savings, the new design Brown & Sharpe Automatics maintain close tolerances for size and concentricity, and meet the highest standards for surface quality.

Find out how you can use B&S Automatics and attachments to trim down the cost of parts that now require extra machining. For complete information, write: Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

**The three jobs** shown above are examples of unlimited opportunities for cost-reduction by using B&S attachments to combine more operations within the bar machining cycle. Thirty standard attachments are available for B&S No. 00 and No. 2 Automatics, and special attachments are designed as needed. Let B&S Screw Machine specialists survey your operations and recommend new set-ups for work-hour savings.

**Brown & Sharpe** PRECISION CENTER

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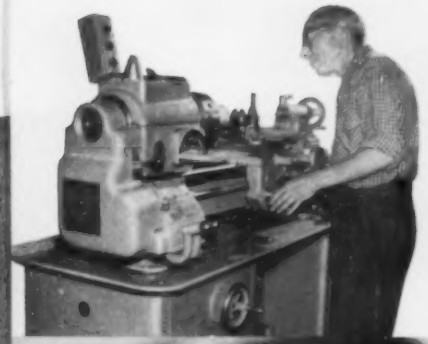


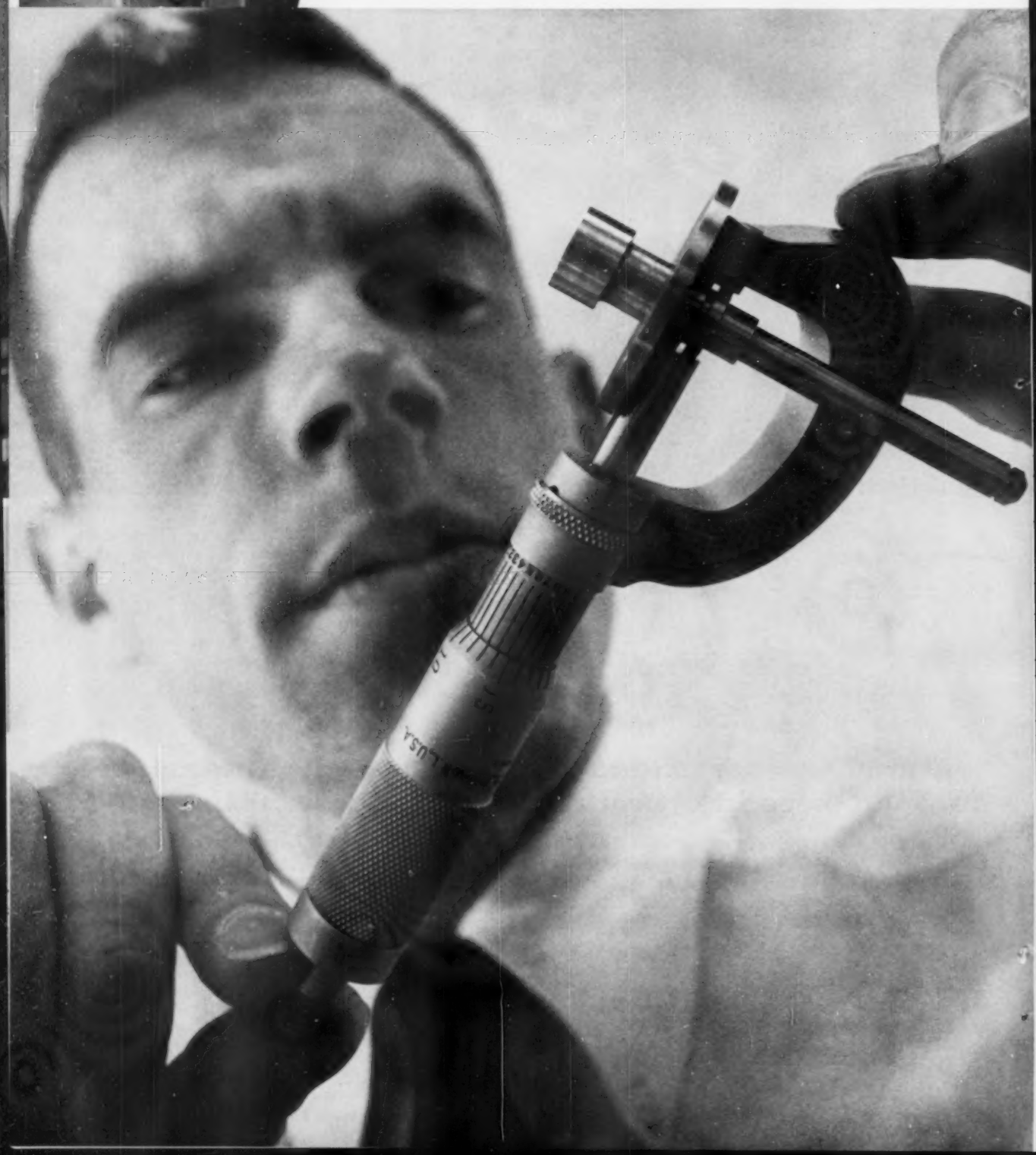
# You can do more with DELTA Metal Lathes

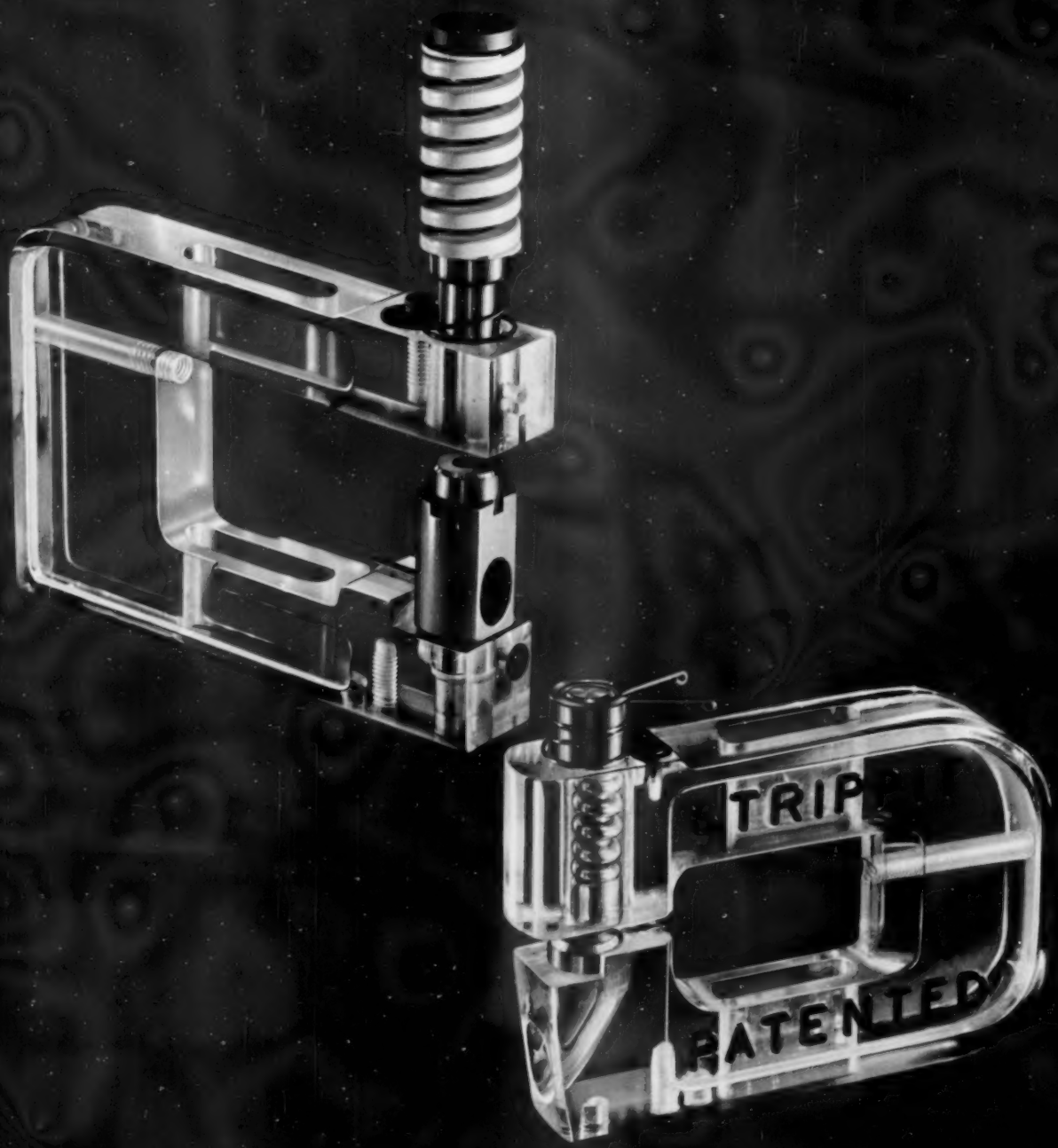
Checking closely on tolerances, time and dollars? These accurate, versatile, low-cost machines can pay their way on your jobs. To see a Delta Metal Lathe in action, write for the name of your nearest Delta Lathe Dealer and get a FREE CATALOG: Rockwell Manufacturing Company, Power Tool Division, 620E North Lexington Avenue, Pittsburgh 8, Pennsylvania.

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL






Get the inside story on cost saving STRIPPIT hole-punching units at the tool show-booth 1305

STRIPPIT bares all at the Tool Show. In addition to these transparent plexiglass holders that show exactly how STRIPPIT "BN" and "CJ" self-contained hole punching units are put together, you'll see actual demonstrations of STRIPPIT machinery in action and a display of all the other cost-cutting STRIPPIT sheet metal hole punching and notching units.

STRIPPIT Super 30 Fabricator punches round and shaped holes in workpieces 60" wide—any length. This amazingly versatile machine will also punch close-centered hole clusters in any material up to ¼" thick ... notch and nibble square or contour cutouts in ⅛" material. Standard and special tools interchange in seconds. The Super 30 also features an indexed tool holder, micrometric gaging and an adjustable work table.

# Stop at booth 1305 for positive proof that STRIPPIT cuts costs

STRIPPIT 15-A Fabricator saves you days or even weeks of time by eliminating tool designing and die-making. A new unique micrometric gaging system enables you to punch complicated patterns of round and shaped holes directly on this machine ... to exact layout specifications ... in minutes. The STRIPPIT 15-A also notches and nibbles sheet material.

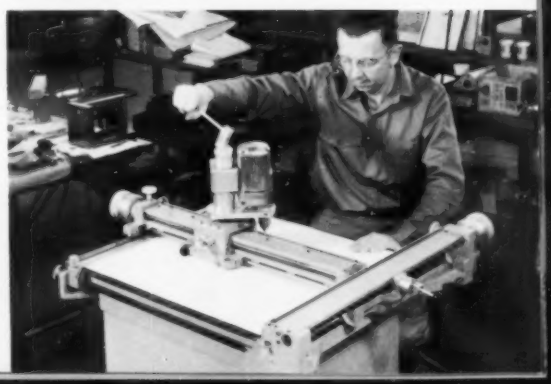
STRIPPIT Duplicator functions like a pantograph to reproduce any hole pattern from a drilled or punched template. No custom dies are needed to turn out precision sheet metal parts in volume. The STRIPPIT Duplicator is a valuable accessory for both the Super 30 and 15-A Fabricators.

WALES **STRIPPIT** INC. HOUDAILLE INDUSTRIES INC.

**Buell Road • Akron, New York**

*In Canada: Strippit Tool & Machine Company, Brampton, Ont.; In Continental Europe: Raskin, S. A., Lausanne, Switzerland; In the British Isles: E. H. Jones (Machine Tools) Ltd., Hove, Sussex, England.*

STRIPPIT Flex-O-Drill drills, reams, center punches and scribes with tool room accuracy ... ±.002". By eliminating the need for base line drawings and vernier height gages, the Flex-O-Drill can reduce template making time 50% or more. Want an accurate machine for checking drawings, patterns, templates or production pieces? A new, inexpensive accessory converts the Flex-O-Drill to this dual purpose.



'61

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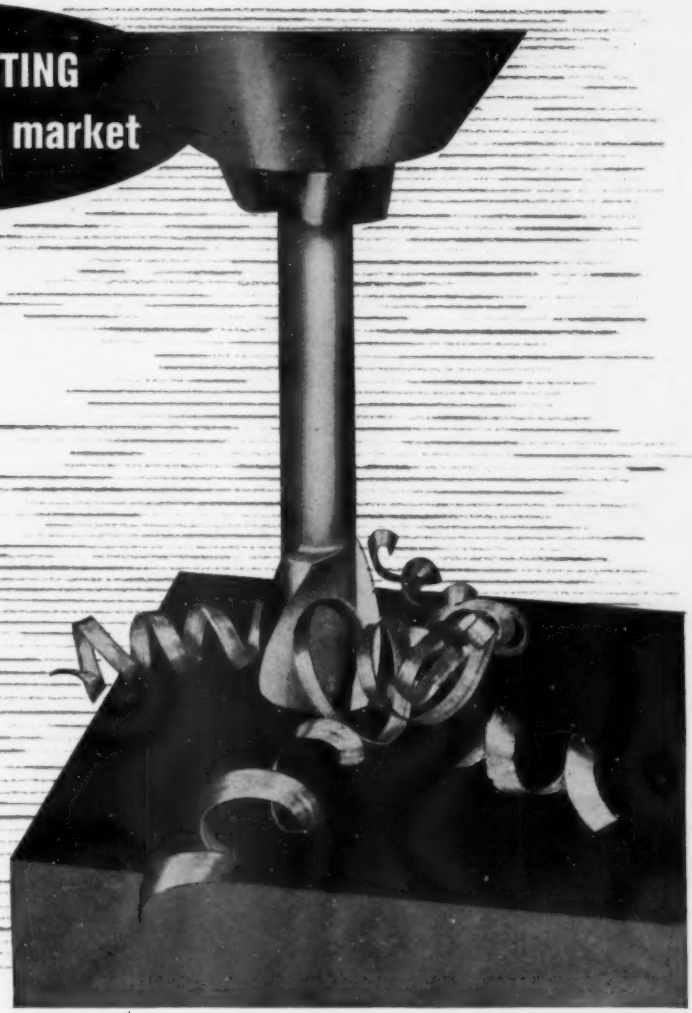
**Now–designed for new "1960 SERIES" socket head cap screw standards**

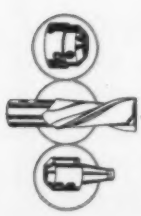
OVER 40 YEARS OF LEADERSHIP SINCE 1918



# WELDON "TU-LIP" COUNTERBORES

## Cut production costs and stay sharp longer because:

- Ample chip room prevents breakage caused by clogging
- Fast helix of the two flutes results in improved cutting action
- Solid pilot without grooves will not ream or mar the hole
- Only two cutting lips to regrind, cuts tool room sharpening time



**THE WELDON TOOL COMPANY**

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Weldon distributors throughout U. S. A. and Canada carry complete stocks to serve you.

A-4195A

# SINGER*

**NUMERICAL CONTROL**

## BUY THE COMPLETE PACKAGE...

FOR THE O.E.M. . . . SINGER Numerical Control . . . the most direct approach to point-to-point positioning . . . offers speed, capacity, versatility, a high degree of accuracy . . . and is available at a low initial investment. The system is sold as a package, complete and ready for installation, including the tape reader. It requires only the measuring bars to suit the specific machine. The SINGER system offers a high degree of accuracy, for drilling, jig boring or milling . . . ±.001 inches on a work table and up to 40 inches of travel.

## ...OR THE COMPONENTS

For the buyer who wants to acquaint himself with the advantages of automatic positioning, rather than buy a complete package, the SINGER system is ideal. Because of SINGER'S modular design, a machine can be furnished with the automatic positioning system only. At a later date, tape control can be readily added with no sacrifice of the original investment. It is important to know, too, that all modules and motors are designed, serviced and built by Diehl Manufacturing Company, a SINGER subsidiary. Call or write for an appointment at the address below.

Shown here is SINGER Numerical Control applied to the new Veetmatic Precision Drilling Machine. This electrically-operated system provides more economical operation at greater accuracies than conventional layout drilling procedures.

See SINGER Numerical Control applied to the new Veetmatic Drill at the ASTME Show in New York (Booth 2135), May 22-26, 1961.

Diehl† **DIEHL MANUFACTURING COMPANY**

SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY
Finderne Plant, Somerville, New Jersey
Telephone: Randolph 5-2200

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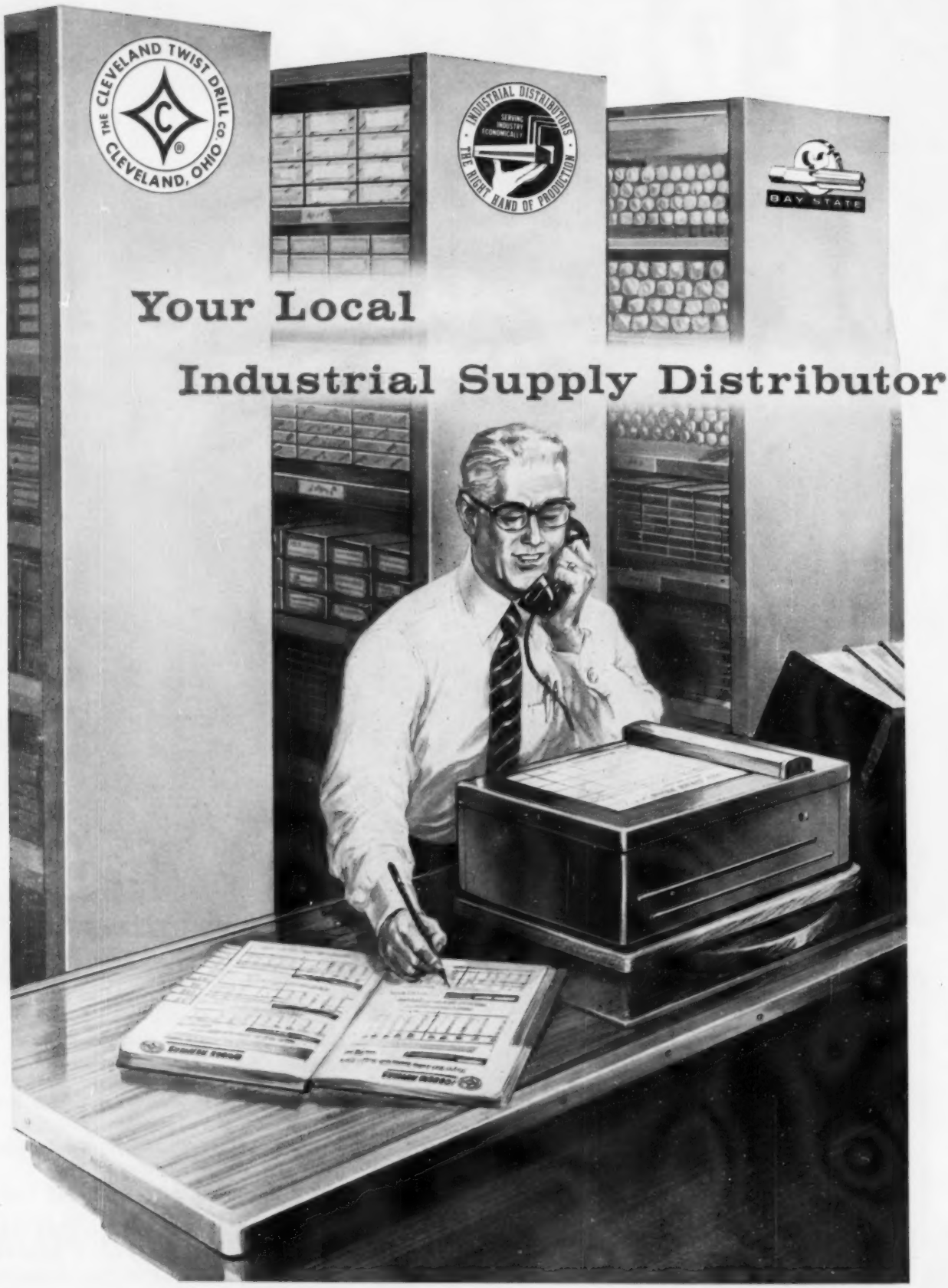
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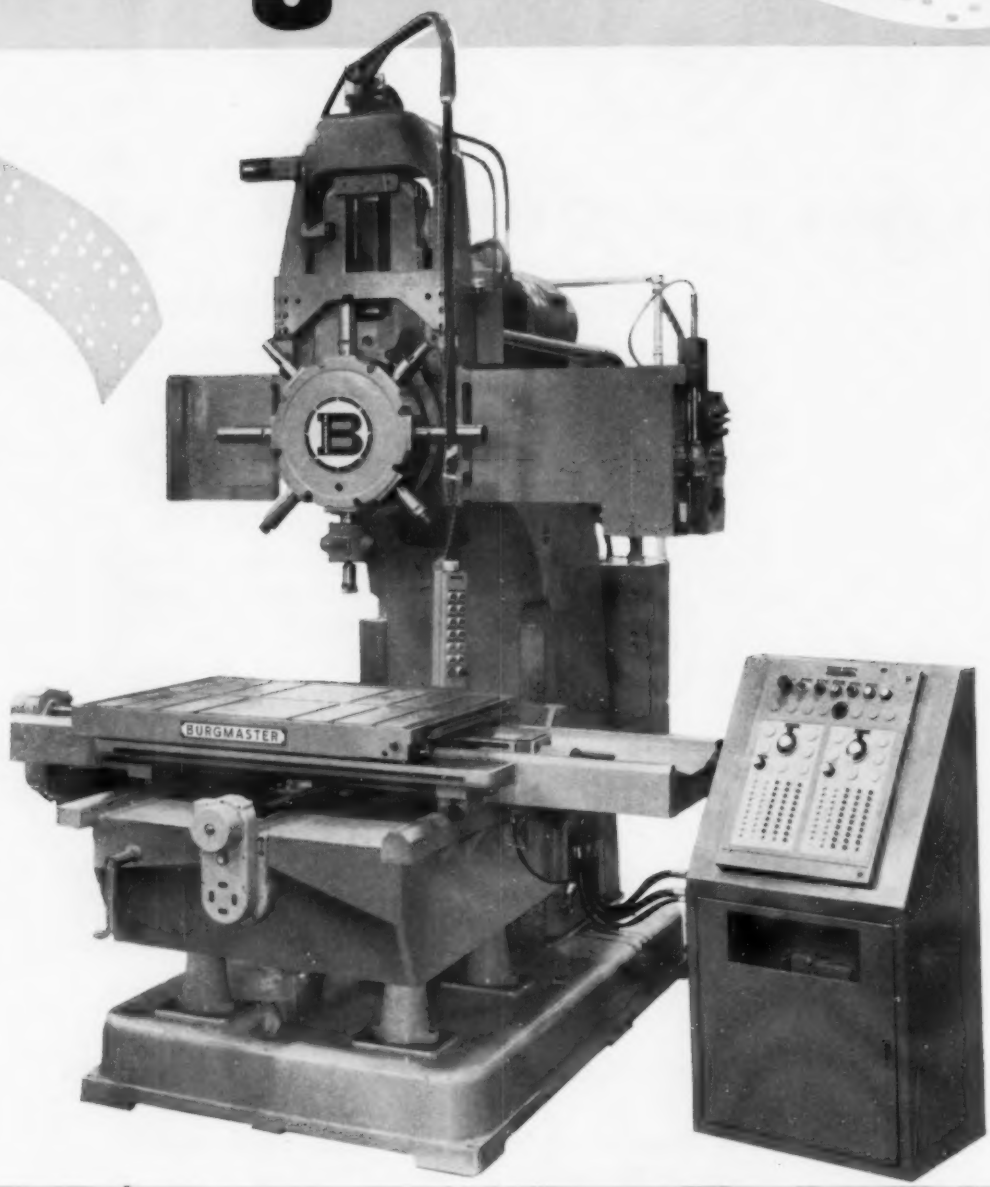
# 10 COST REDUCING FEATURES OF Burgmaster

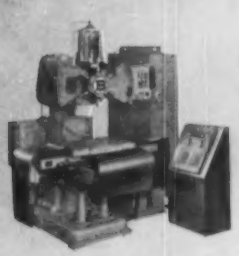
**ACCURATE**

**RIGID**

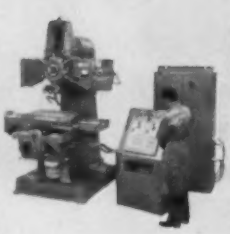
**FAST**



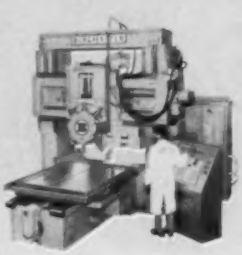

**MODEL 3BHT**
8-spindle, 1½" capacity in steel. Table travel 20 x 30, 30 x 45.



**MODEL 2BHT**
6-spindle, ¾" capacity in steel. Table travel 10 x 18, 15 x 26, 20 x 30.



**BURGMASTER MODEL 25AHT**
6-spindle, 1¼" capacity in steel. Table travel 15 x 26, 20 x 30, 30 x 45.



**MODEL 3BHT-B DOUBLE HOUSING, PLANER TYPE**
8-spindle, 1½" capacity in steel. Table travel 48 x 60.

TAPE-CONTROLLED

**World's Largest Builder of Turret Drilling Machines**

# TURRET DRILLING MACHINES

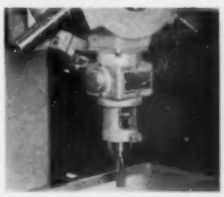
## 1 MACHINE RIGIDITY

Burgmaster components are well proportioned stable Moly Iron castings engineered with proper wall thickness, and extensive internal ribbing in the right places to provide the rigidity and stability required.

## 2 TURRET CLAMP RING

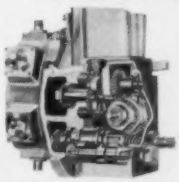
Increased accuracy is provided for heavy machining operations because turret is rigidly held against the face of the slide and securely clamped by an automatic acting "V" type external clamping ring.

## 3 LEAD SCREW TAPPER



The Burgmaster Lead Screw Tapping Head greatly improves the finish and accuracy of tapped threads and eliminates scrap due to pulled or loose threads. Capacities range from ¼" to 1⅛" in steel.

## 4 FOOL PROOF, ACCURATE TURRET INDEX



through Geneva mechanism with shot bolt locator and turret clamp assure .0004" TIR Index accuracy one spindle to another.

## 5 RUGGED SPINDLES

mounted in sets of reloaded double and single row, ball bearings, or Timken Roller Bearings assure minimum runout (.0004" TIR max.).

## 6 CONTROL STATION MOUNTED DEPTH STOP DRUM

For setting depth stops and rapid traverse lengths are located at the operator's control station within easy handling distance for convenience and speed in making set-ups. (60" from floor on 3BHT).

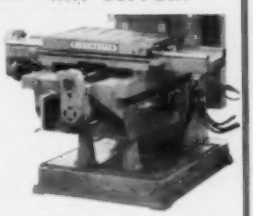
## 7 10 TAPE CONTROL SYSTEMS

Ten different tape control systems are available with Burgmaster Turret Drills. This represents more systems than have been applied to any other drilling machines. In addition, more Burgmasters are tape controlled than any other type or make of machine.

## 8 MILL FUNCTION — RECIPROCATING DEEP HOLE DRILLING 3 AXIS CONTROL — OPTIONAL

1. Burgmaster 3BHT tape controlled turret drills are rugged enough for milling cuts.
2. Reciprocating feed modification permits deep hole drilling with fine finish.
3. 3 axis tape control provides automatic depth control or circular table control — speeds setup, increases machine versatility.

## 9 HEAVY TABLE FULL WAY SUPPORT



Burgmaster tables are mounted on extra deep carriages, and the ways are twice the length of table travel in both X and Y motions with no table overhang. Tables are supported by double, synchronized, single crank operated, jack screws to eliminate deflection under load. Larger tables have four jacks.

## 10 PRE-SELECTIVE SPINDLE FEEDS — SPEEDS

Pre-selective feeds are infinitely variable from ¼" to 50" per minute, automatically pressure and temperature compensated which assures constant feed rates, as indicated on Feed Rate Meter at all times.

### PRE-SELECTIVE SPEEDS

A wide range of 12, 24, or 32 speeds provide the right rate for most efficient machining and long tool life.

# Burgmaster CORPORATION

15001 S. Figueroa Street, Gardena, California, FAculty 1-3510 DAvis 9-4158

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Write for bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. Forty minute 16 mm sound film showing all Burgmaster Turret Drills in operation is available without charge from any office.

BURGMASTER B

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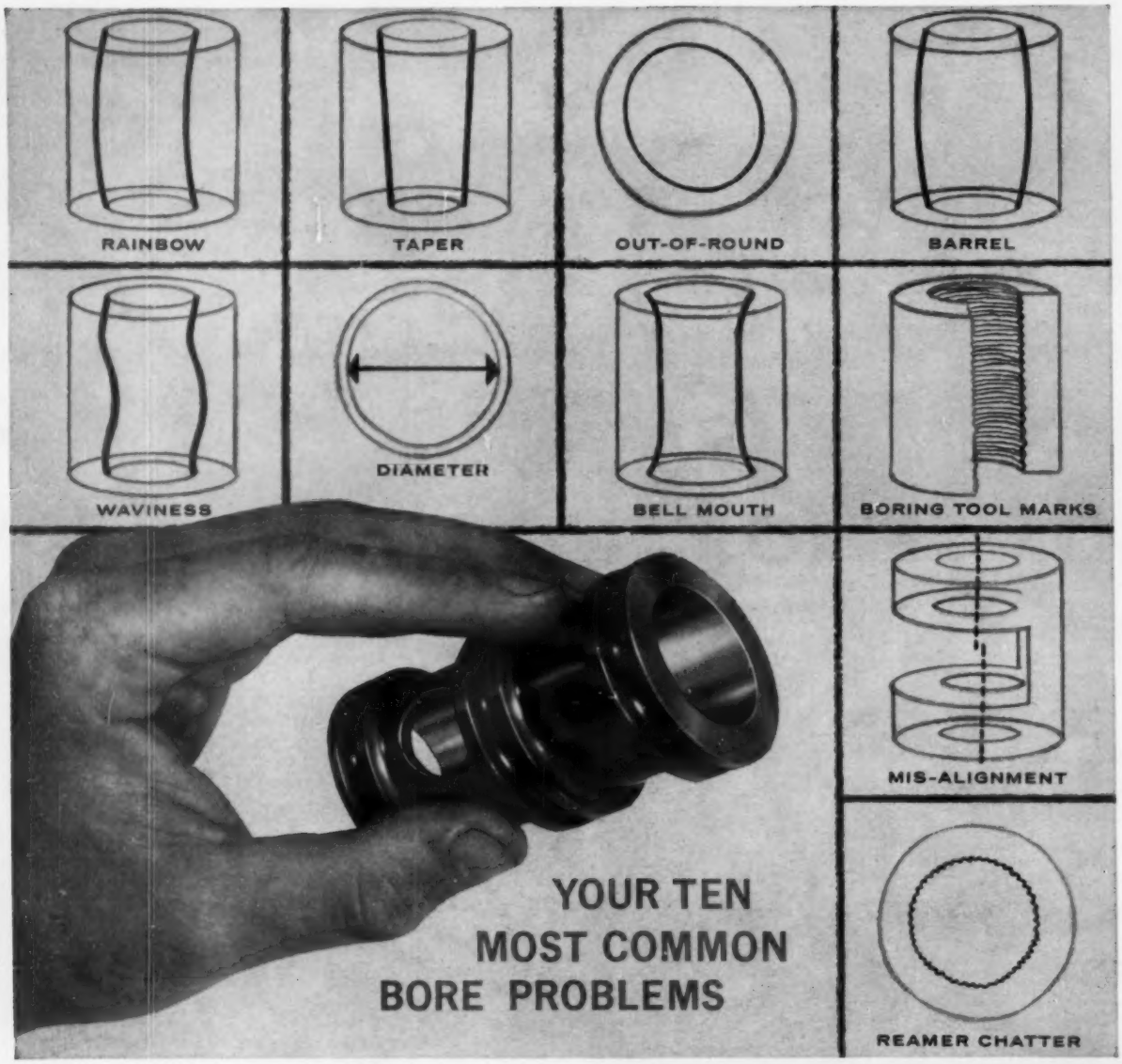


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All these bore errors from previous operations can be corrected fast and with minimum stock removal by Sunnen Honing.

This fast abrasive stock removal process is often used to take out substantial amounts of stock as well as for final sizing.

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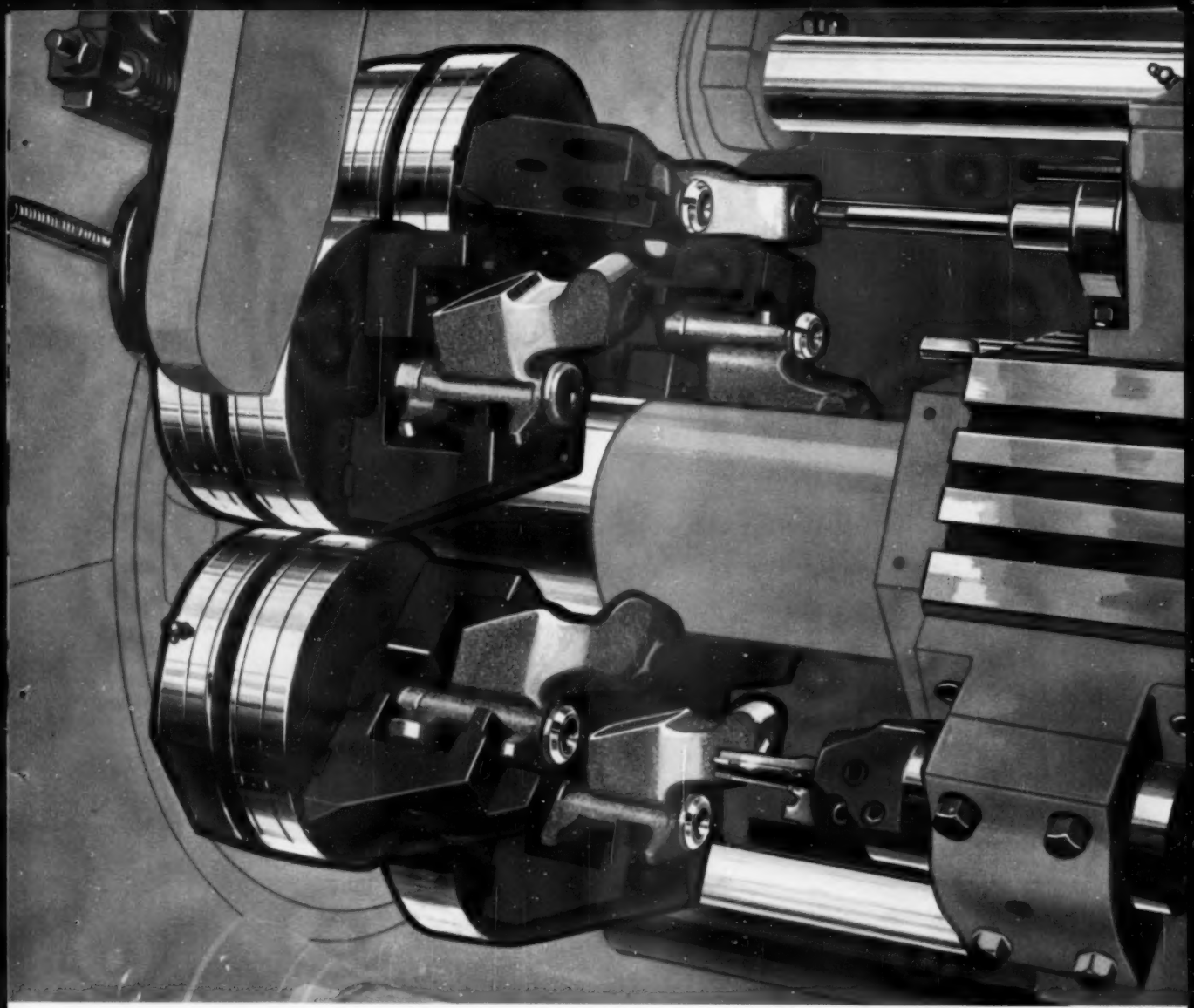
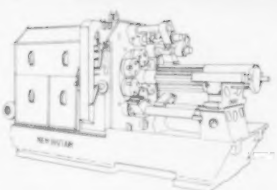


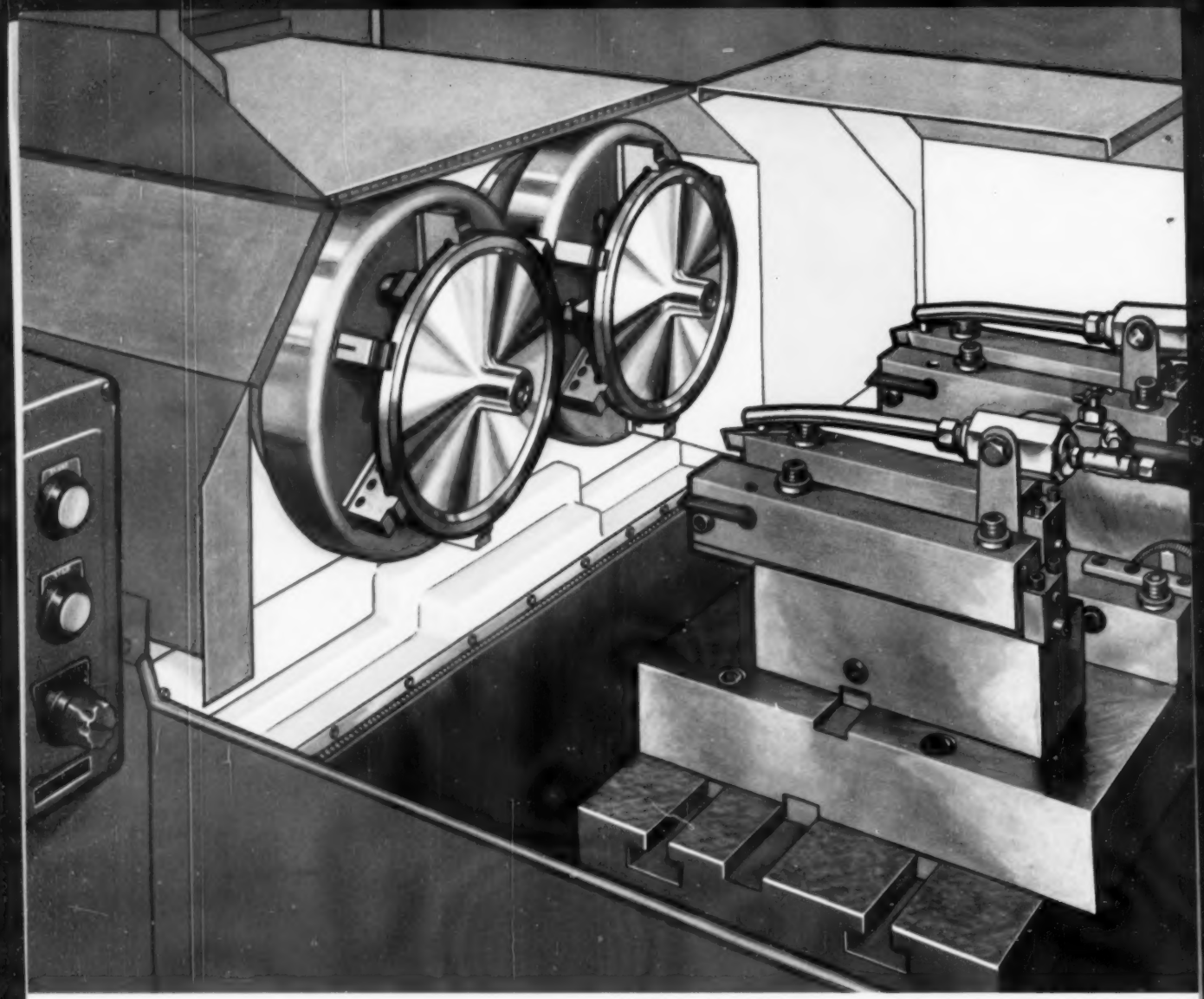
# Odd shapes no problem
## *on New Britain Chuckers*



The peculiar problems presented by odd shaped pieces are frequently as varied as the pieces themselves. The cut may be simple enough but the how and wherefore of chucking and swinging the piece may be something else again. New Britain Chuckers can handle the widest possible range of pieces—even odd shaped work. Open-end design which allows wide open accessibility to the tooling area makes the work easier to chuck, and easier to watch during the machining cycle. Because the work area is more open, this kind of work is easier to swing on a New Britain. This is one of many extras that are built into New Britain Chuckers. Another basic New Britain difference that pays off handsomely is the exclusive forming arm design which allows for the greatest possible variety of side cuts without special set-up. The combinations of end-working and forming cuts possible are practically unlimited. This flexibility of tooling coupled with big capacity lets New Britain users perform the widest possible variety of chucking machine work. Why not call in your New Britain representative?

**THE NEW BRITAIN MACHINE COMPANY**

**New Britain-Gridley Machine Division • New Britain, Connecticut**



# New Britain cam actuated *boring and contour turning*

Extreme accuracy, high productivity—even on complex contoured surfaces—these are the areas where New Britain's Vertical and Horizontal Precision Contour Turning and Boring Machines take the kinks out of production. Tool slides are cam actuated, generating contoured and straight surfaces, including sharp corners and exact radii. Time consuming wheel forming and dressing required by some methods of producing close tolerance, fine finish work are eliminated.

This is basic with New Britain and is a good part of the reason for the unbeatable repetitive accuracy of these machines. Both verticals and horizontals are simple to operate and simple in operating principle. Normally, gaging one dimension is sufficient. From one to four high speed spindles can be mounted on a single machine.

The widely accepted horizontals, or the completely new and revolutionary verticals with exclusive cam-in-head design, can be seen in action simply by contacting your New Britain representative. Whether you require one machine, several machines, the best approach to a building-block set-up, or whatever your precision contour turning or boring requirement may be, check with New Britain before you decide.

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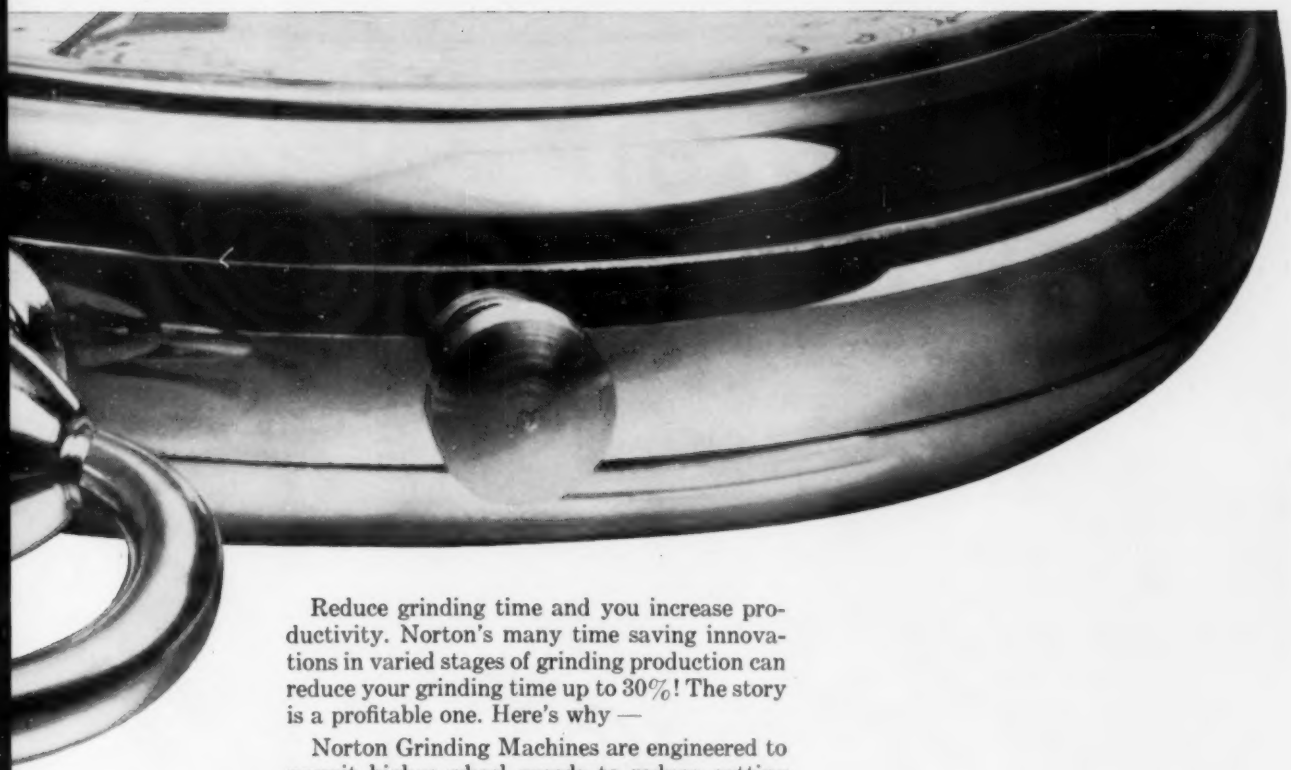
# Time is the measure of productivity



Reduce grinding time and you increase productivity. Norton's many time saving innovations in varied stages of grinding production can reduce your grinding time up to 30%! The story is a profitable one. Here's why —

Norton Grinding Machines are engineered to permit higher wheel speeds to reduce cutting time. Norton's *Automatic Wheel Balancer* balances the wheel in *five seconds — on the machine.* You reduce time spent "grinding air" up to 85% because of Norton's *Automatic Wheel Contact Accelerator* which speeds the wheel to the work and compensates for work piece-diameter variation. Another advance is Norton's *Automatic Truing* which eliminates work interruptions and the *Automatic Wheel Wear Compensator* that stabilizes the grinding cycle.

Norton Grinders further add to your productivity by minimizing work spoilage with *Automatic In-Process Gaging.* In the case of surface grinders Norton *Higher Table Speed of 150 fpm* actually reduces grinding time up to 50%.

These are only some of the many reasons you can increase your productivity with Norton Grinders. They also offer accessories that literally transfer skills to machines — *ultra-fine feed,* and *automatic features* such as *steady resting, endwise locating, loading, constant peripheral wheel speed* and *hydraulically-operated feed screws* provide this competitive advantage.

The decision is yours — can you afford not to reduce the time it takes to produce your product? Can you afford not to increase your productivity? Contact your Norton man, NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. In Canada: J. H. Ryder Machinery Co. Ltd., Toronto 5.

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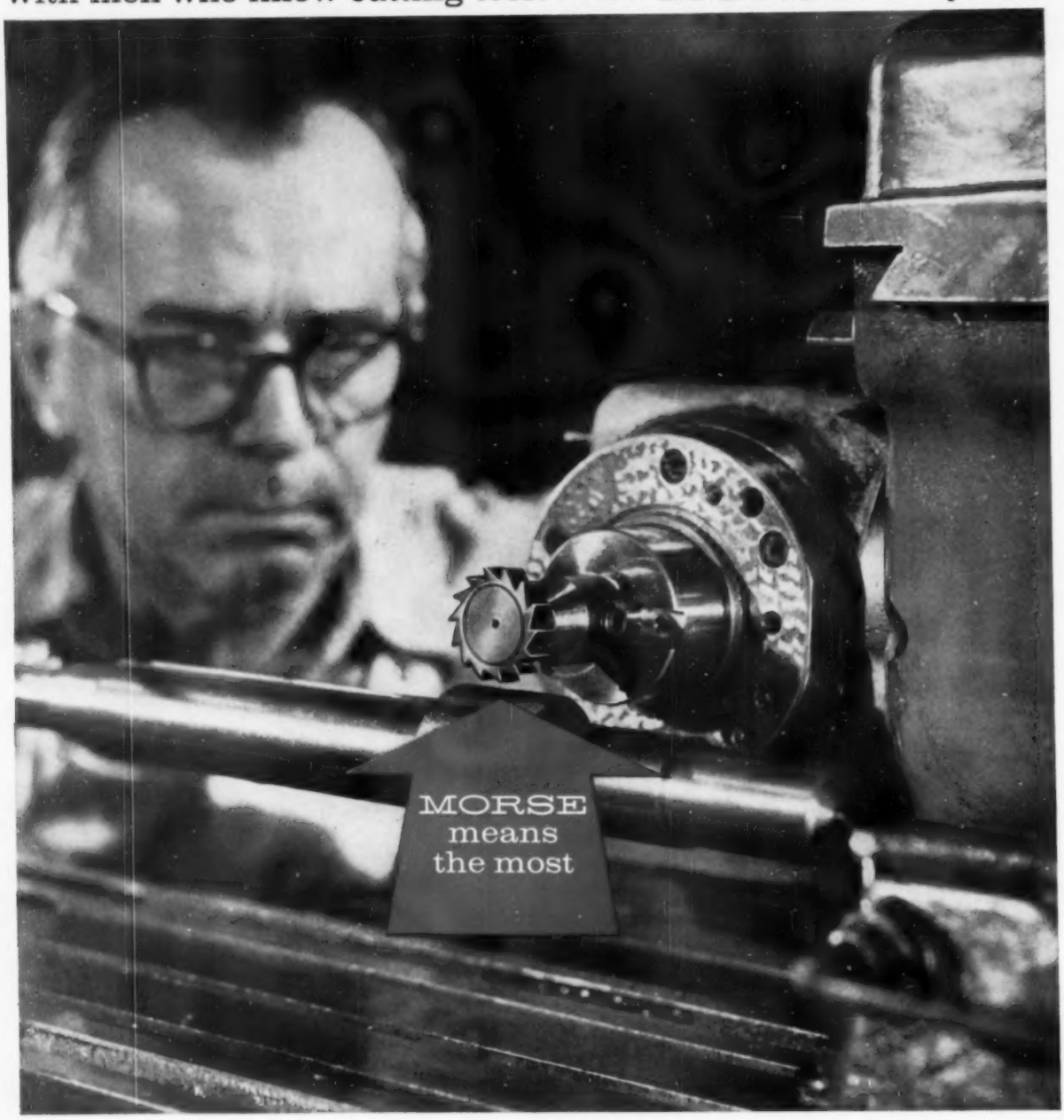


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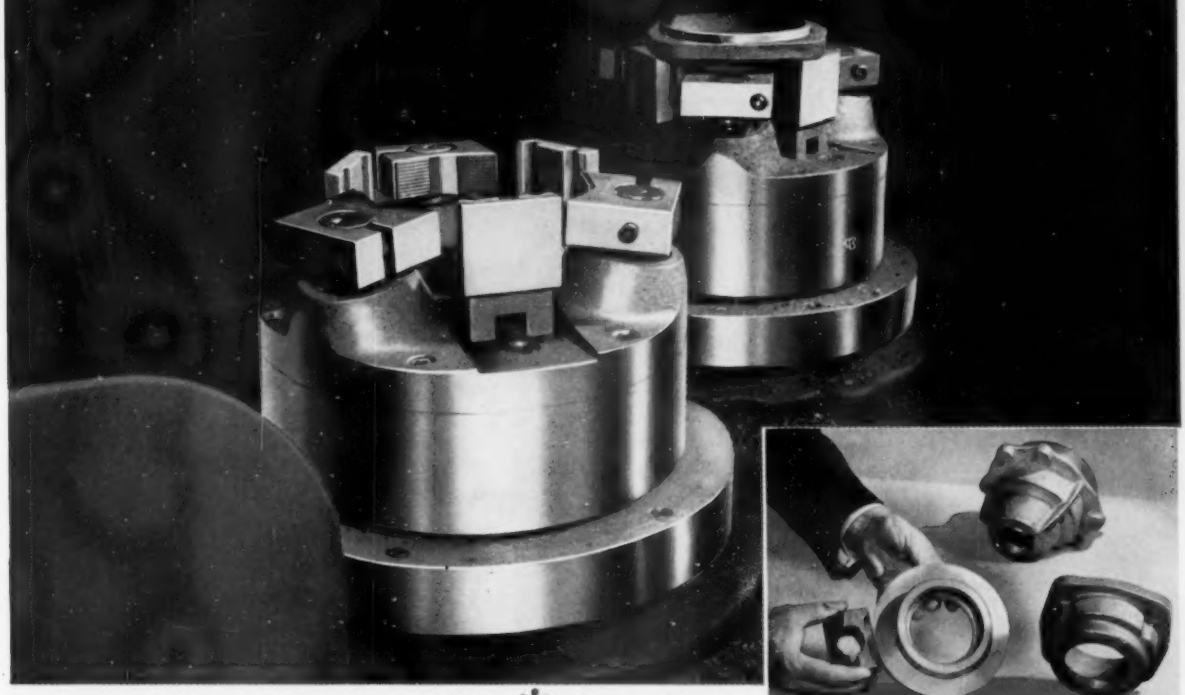
# WORK-HOLDING BY WOODWORTH



## VERSATILE "BALL-LOK" * ADAPTS TO A VARIETY OF PARTS AT FORD MOTOR COMPANY

- **WOODWORTH 3-JAW EXTERNAL "BALL-LOK" CHUCKS** are installed on a 12" 8-spindle Bullard Mult-Au-Matic at Ford Motor Company Tractor Division in Highland Park, Michigan. Interchangeable jaws permit Ford to machine three different parts with varying configurations and set-up time has been reduced considerably. In this instance O.D. of the parts range from 4½" to 6¾". (See inset).
- In the above illustration the set-up is for machining a rear axle oil seal retainer. Material is cast iron and seven machining operations include facing, boring, turning and chamfering. Maximum operating speed is 208 R.P.M., feed .0145 and tolerances of ±.002 are maintained. The I.D. and O.D. must be concentric within ±.004 T.I.R. Approximately 50 pieces are produced per hour.
- The jaws of WOODWORTH "BALL-LOK" CHUCKS hold the part securely with uniform clamping pressure. Additional "pull back" action draws the work piece against positive stops, providing increased rigidity during machining operations.

The special tooling was installed on this machine by Schulze and Burgess of Warren, Michigan.

* *WOODWORTH'S new "BALL-LOK" POWER CHUCK design is the first basic improvement in chucking in 100 years! An entirely new concept in power chucking, the "BALL-LOK" features completely sealed and lubricated mechanism and tremendous gripping power.*

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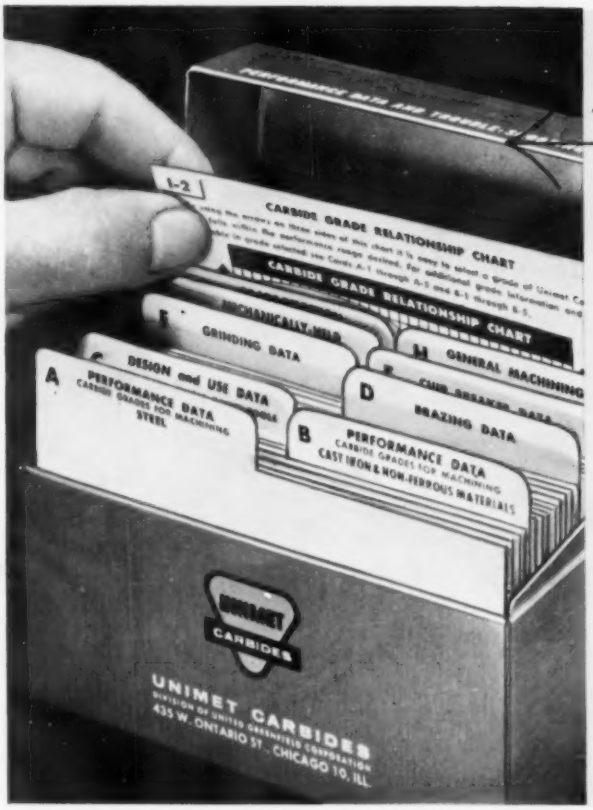


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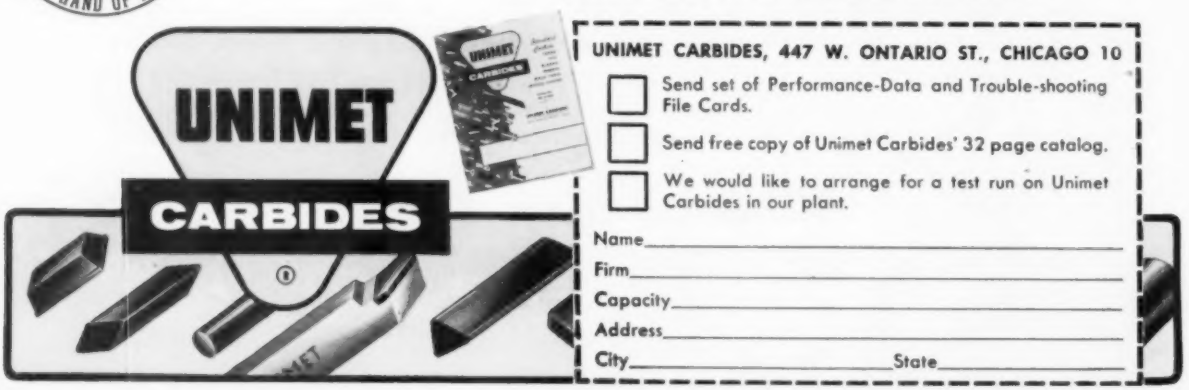


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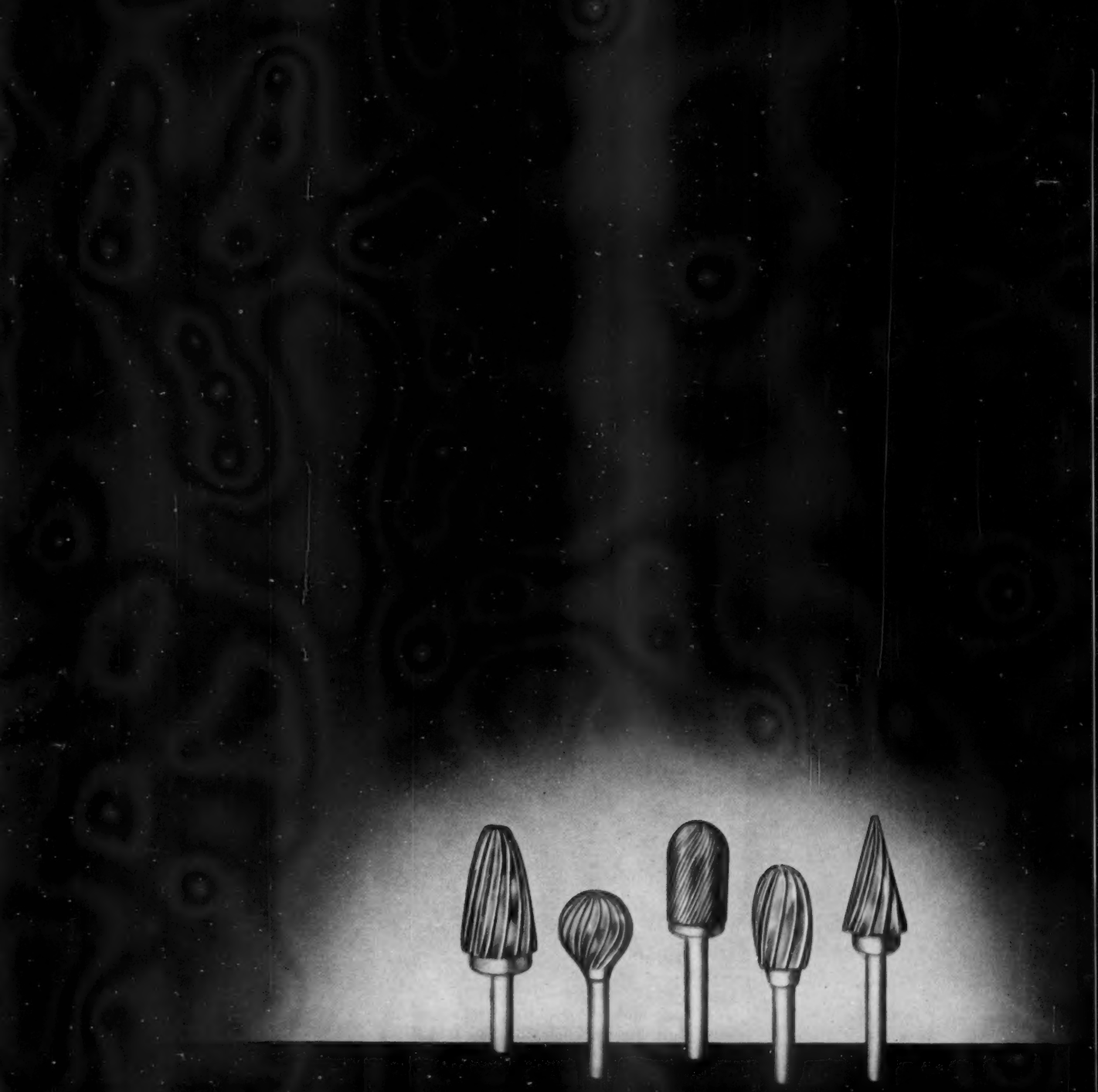

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Today, at the threshold of a new era, when new worlds are opening up at an ever-increasing speed, new tools must be created to meet the requirements of our new technology. Rotary files are increasingly used in thousands of operations for metal removal and finishing, on all kinds of metals. Higher speeds and new materials present special problems and old problems, such as chip removal, assume even greater proportions.

To meet these new requirements, the Grobet File Company of America has developed entirely new types of Rotary files, such as the Facet Tooth® and Bi-Dex® Tungsten Carbide Rotary Files. These major advancements reduce chatter, facilitate the removal of chips and greatly increase speed, ease and efficiency of operation.

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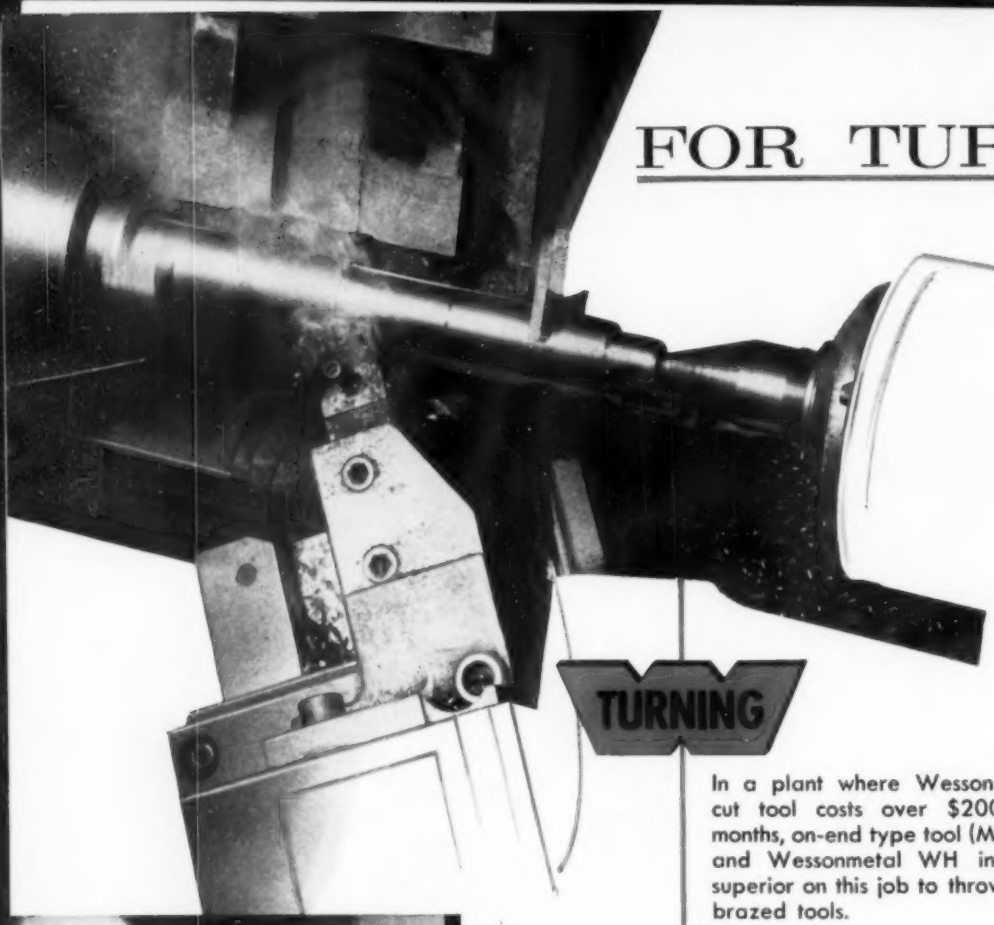
# FOR TURNING . . .

*how to*



## TURNING

In a plant where Wesson job-analysis cut tool costs over $200,000 in 18 months, on-end type tool (MX8-T5 holder and Wessonmetal WH insert) proved superior on this job to throw-aways and brazed tools.

## BORING

A Wesson man pre-engineering the tooling for boring track-links of 325 Brinell. Result: over 200 pcs. per grind from the start. Wessonmetal solid WH inserted blades used.

## MILLING

Safety at almost 1½ miles a minute is job-engineered into this Wesson T-72 Rigidcut with Wessonmetal GI blades. The faster it cuts, the tighter the blades seat. Lubrication is centrifugal to each blade through holes in the body . . . and you don't have to reset blades every time you grind.

WESSON COMPANY • WESSON RESEARCH •

# . . . THROW-AWAYS, ON-END TYPE, or BRAZED?

## *make it easier to decide...*

With the new Wesson T-A holder, old troubles with throw-away holders for turning have disappeared like magic. Easily indexable in any position, with only two major units, fully adjustable, the new Wesson T-A is the result of 3 years of research and 25 prototypes.

New developments like this make it important to take another look at your own tooling. Where will it fit in best? Where will Wesson band-type or brazed type tools do better? Here the Wesson man in your area can be of real help to you:

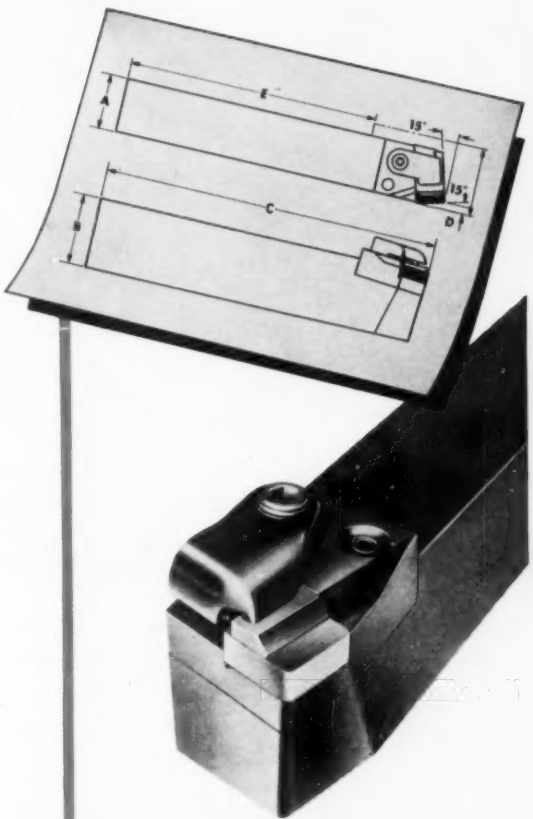
1. **His recommendations will be unbiased, since Wesson makes ALL THREE types**
2. **He has a thorough knowledge of which works best under different conditions**
3. **He was picked for his turning, boring and milling know-how**
4. **He will job-engineer your applications in your plant**
5. **He will see to it that the tools you buy will give you best possible performance**

Let him work for results in your plant like those shown at the left. He costs you nothing. He is as near as your telephone.

He is backed by the combined experience of the entire group of Wesson's 4 specialized tool plants, plus Wesson's basic research and tool engineering groups, plus Wesson's own carbide metals plant.

Ask him for a copy of "HOW TO TURN WITH THROW-AWAYS, BAND TYPE OR BRAZED TOOLS". Or, if you prefer, ask us for a copy right now. It helps you make it easier to decide which type of tool to use.

*Wesson Company, 1220 Woodward Heights Blvd., Ferndale 20, Michigan. In Canada: Wesson Cutting Tools Ltd., 93 Judge Road, Toronto 18, Ontario.*




**New and Now In Mass Production**

The Wesson T-A (throw-away) holder is simplicity itself . . . to use, to index, to stock. It has only two units . . . the shank with its 2 in 1 flat-seat anvil-locator and the clamp unit with wide range adjustment and adjustable solid carbide chip-breaker. Ask for Bulletin T-160.

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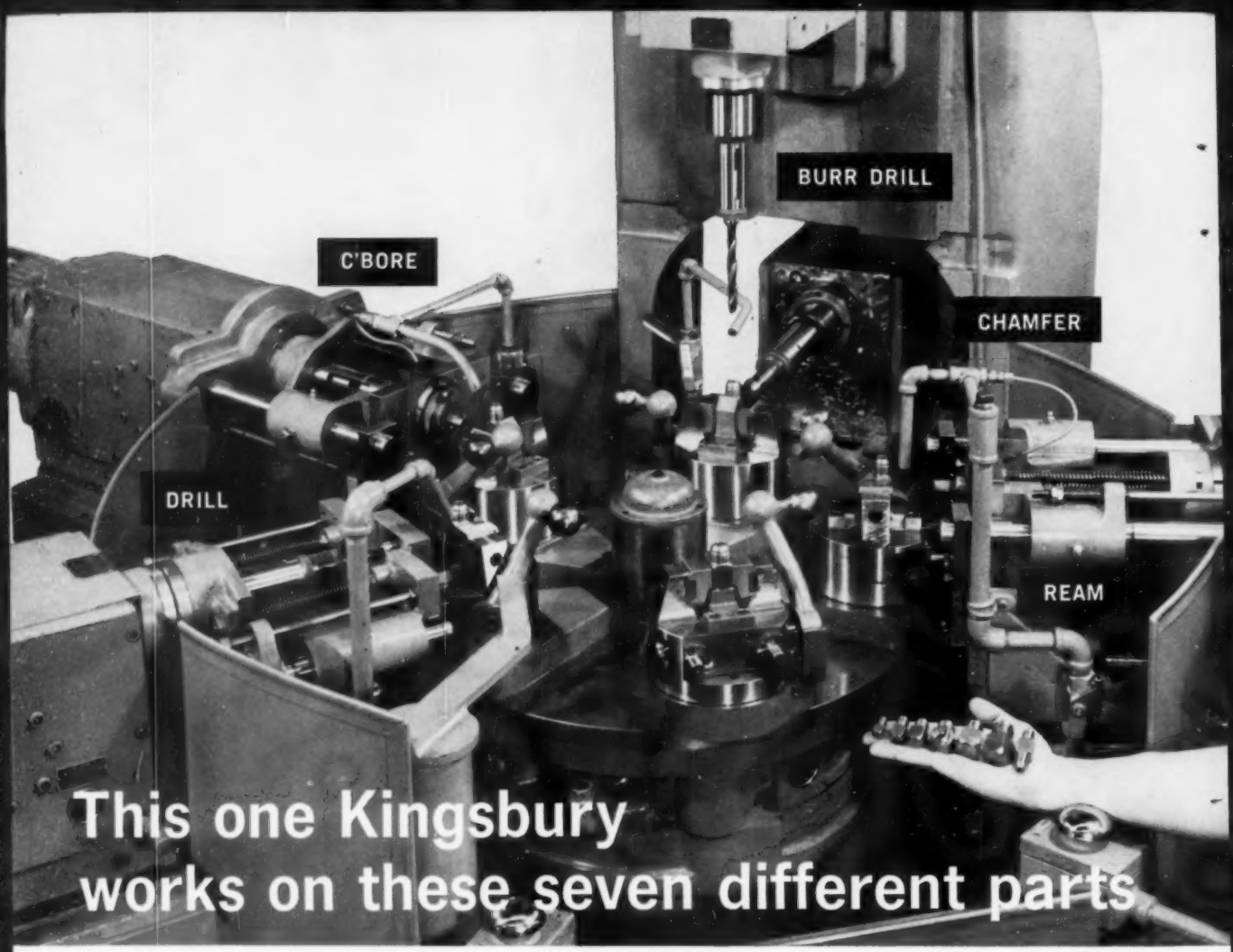
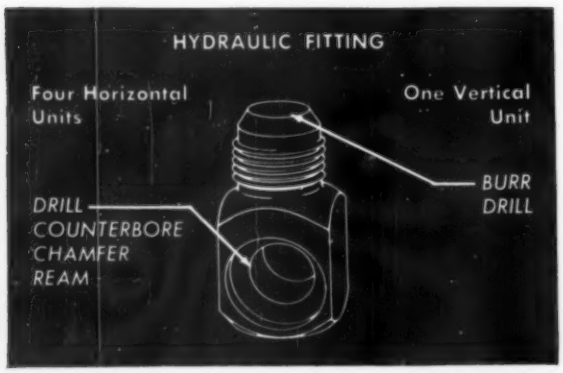


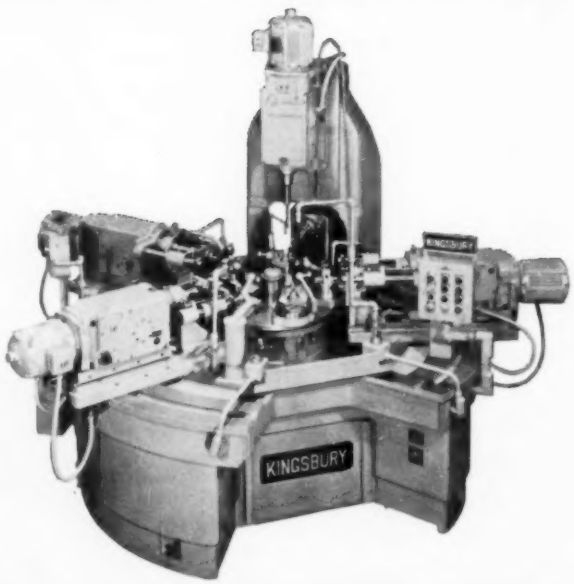

# This one Kingsbury works on these seven different parts

This Kingsbury machine is fairly simple — just five units and six stations. The work pieces are held in two-jaw chucks with interchangeable locating jaws and clamps. The gross production rate for five parts is 500 parts per hour. On the sixth part it is 340, and on the seventh part with two chuckings it is 250 per hour.

Normally our machines are far more complex than this. But this one does show that our simpler machines also pay off. With good basic design and rugged accurate construction, they have little downtime. And uniform, accurate cycles produce little scrap.

May we quote you on a job, either simple or complex? Kingsbury Machine Tool Corp., Keene, New Hampshire.

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***PRODUCT QUALITY ASSURANCE**

PQA is the symbol of unquestioned quality at Allen. It stands for constant quality control from rigid upgrading of incoming raw materials to final, *unconditionally guaranteed* shipment to you.

To give you some idea: Federal Spec. FF-S-86a calls for 4,950 lbs. for the ¼-20 cap screw. Day-in, day-out breaking point tests of these screws prove that Allens are *consistently* better . . . well above the minimum requirement!

Quality checks like this one confirm PQA every step of the way through Allen's manufacturing process. And to help you keep costs down and profit margins up, Allen manufactures 1457 standard sizes.

Remember . . . it costs you no more to have *genuine* Allens right from stock, and they are only a minor fraction of your assembly costs.

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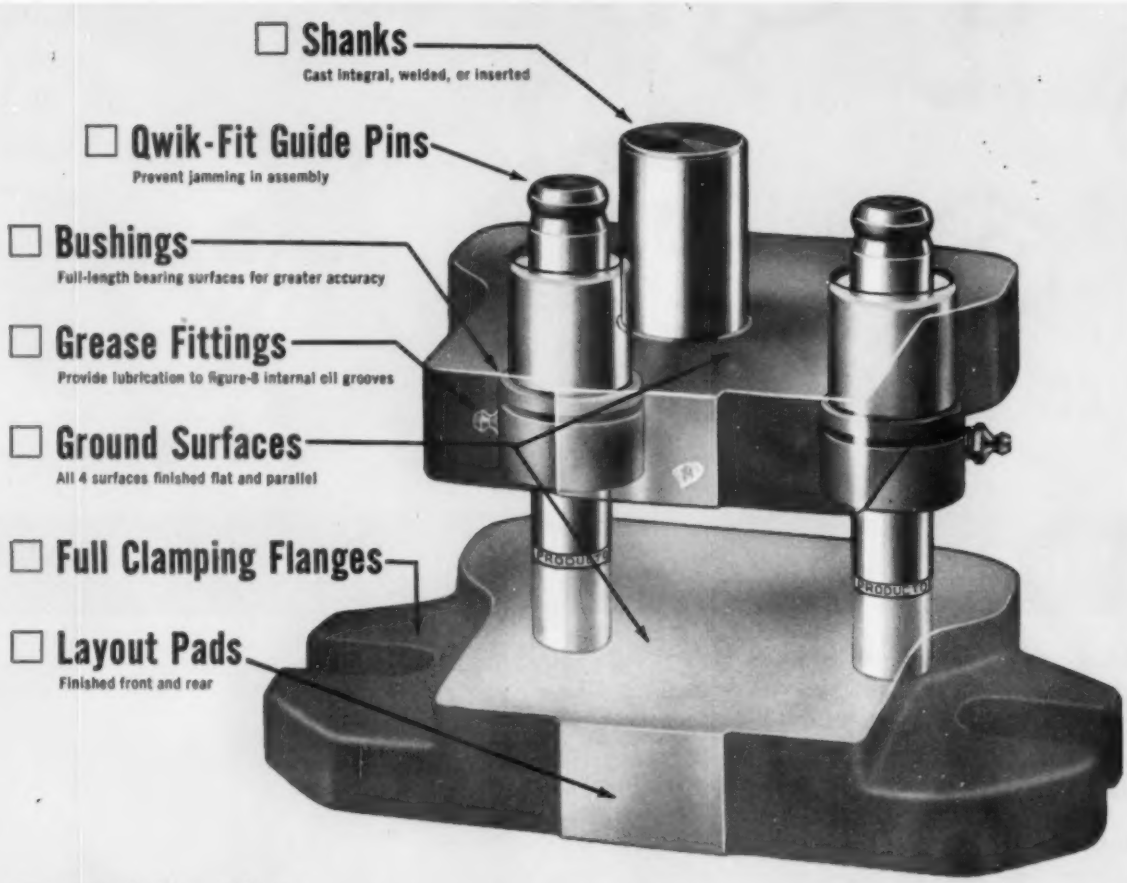
ALLEN HEX-SOCKET SCREWS HEAD

# Check the benefits you get in a Producto Die Set...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# PRODUCTO

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## There Is No Substitute for Seeing

When I started to work for my present company 21 years ago Mr. Scully, who had founded the business in 1912, insisted on my working in every department of the manufacturing and engineering divisions. He firmly believed in "book learning" but thought there was no substitute for seeing and doing all operations. Mr. Scully was one of the wisest men I ever knew.

There is also no substitute for seeing the results of the research and development of new manufacturing equipment at our ASTME Exposition, May 22-26 at the Coliseum in New York City. There you will have a golden opportunity to increase your knowledge of manufacturing technology by participation in the technical sessions and plant tours concurrent with the Exposition.

I hope you and your company desire to get business and make a profit in these days of tough domestic and foreign competition. Planning to spend several days at the ASTME Exposition, Technical Sessions and Plant Tours in New York will help solve your problems. You can't compete successfully or profitably with jet speed competition by using horse-and-buggy manufacturing equipment and methods. See you in New York.

This is my last editorial as your ASTME president. It has been a great privilege to get to know so many of the men who have played and are playing key roles in supplying the material goods essential to mankind's advancing standard of living. I thank the great men who built the ASTME road as well as the dedicated men who are giving years of their lives to removing the sharp curves and leveling the rough spots for the high speed we must travel in the future to maintain our leading position.

I see a bright future for ASTME. Our ultimate purpose is to provide a better material world for mankind—a worthy goal. Through you and the thousands of our members around the world, together with the strong leaders at the national and chapter level, this will be accomplished. You can be a part of that bright future by advancing and applying your knowledge of manufacturing technology.

*Dale Long*

PRESIDENT
*American Society of Tool and Manufacturing Engineers*


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# revolution in MANUFACTURING

## *Part 1—Pathways to Progress*

**By T. W. Black**
Senior Associate Editor

**Revolutionary developments in manufacturing are possible during the next 25 years. Whether or not these developments take place depends on the manufacturing industries themselves. The obstacles that stand in the way of advanced technology can be overcome and, in fact, can be turned into pathways to progress.**

DURING THE NEXT 25 YEARS there will be a revolution in manufacturing. The seeds of that revolution —numerical control, computer technology, improved materials and processes—have all been planted since the early 1950's. By 1976 the automatic factory should be an operating reality in many industries, and both over-all productivity and manufacturing efficiency will have been improved by several orders of magnitude throughout industry.

Four factors make this growth almost a certainty. First, the pressure of population growth and the demand for a higher standard of living virtually assure a greatly increased demand for the products of the American manufacturing industries. Second, the pressures of foreign and domestic competition are a powerful incentive to keep the prices of manufactured goods at competitive levels. Third, advances in applied manufacturing technology are being made at a rapid rate. Fourth, the importance of the manufacturing industries to the American economy is being given greater attention and the result should be a more favorable political and social climate for real advances in manufacturing.

These built-in pressures, then, make the growth of American industry almost inevitable. The rate of growth—and particularly the improvement of productivity in terms of labor and facility dollars invested—depends pretty much on the manufacturing industries themselves. If they are quick to take advantage of improved technology, if they contribute to the development of new technology on an important scale, the rate of growth will be explosive. If the attitude is more complacent, the rate of growth will be retarded.

### Technological Time Lag

One factor that has inhibited industrial growth in the past and may impede future manufacturing progress is the time lag between the development of a new manufacturing process, new machine or new type of manufacturing equipment or control, and its general adoption by industry. It is doubtful whether this time lag will be acceptable in a rapidly expanding economy during the next 25 years.

The extent of this time lag is apparent from widely published estimates by government and industry that from one-third to one-half of the machine tools

in use in American plants are technologically obsolete. Technological obsolescence can, in itself, be a barometer of progress in manufacturing. It is an indicator of the extent to which new developments are taking place. But the development of new manufacturing technology means nothing unless it is applied.

Some of the technological lag in American industry is doubtless attributable to unfavorable tax depreciation allowances. The Kennedy administration has shown an interest in correcting this situation through allowances that provide incentives for replacing outmoded manufacturing equipment, so this problem may be of short duration.

Economic conditions, too, affect the rate of machine and equipment replacement. Sales of machine tools and manufacturing equipment fluctuate widely in response to economic ups and downs that are, in the long run, merely transient. Longer-range planning on the part of company management may help to solve this problem. This is a possible avenue to real manufacturing progress.

It should be pointed out that industry itself can definitely help to smooth out cyclic ups and downs in the economy. Massive doses of technological innovation, frequently applied, can do much to keep the economy growing at a steady rate.

### Need for Innovations

Historically, the growth of American productivity has been a gradual one. The emphasis has been on the improvement of existing machines, processes, equipment and manufacturing techniques, rather than on innovation. Innovation is, in itself, a powerful means of overcoming the technological time lag. A company may not care to re-equip its plant on the basis of a 10 or 20 percent improvement in productivity. A 100 percent improvement in productivity is, however, another matter and technological innovations of this magnitude are—or should be—almost irresistible.

The past quarter century has been, by and large, a period of the gradual perfection of conventional machines, equipment and technology, rather than of radical innovation. The number of new machining processes that have been developed is small. Some of these are electrolytic and electrochemical machining, ultrasonic machining, and explosive forming. Only in the field of machine controls have there been revolutionary innovations.

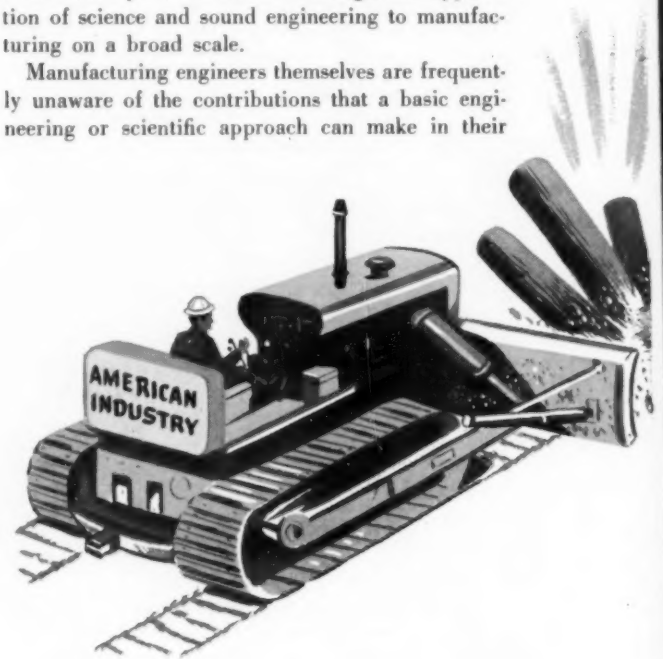
While there may be strong incentives to replace worn-out machines, there is no strong incentive to replace machines that are technologically obsolete but still reasonably productive and in good condition. The difference between the productivity of the older machine and a newer machine designed along the same lines simply may not be great enough to warrant the investment for the newer machine. Only machines based on new concepts, machines with revolutionary new performance, can be economically irresistible in most plants. The development of such machines and methods is one of the avenues to explosive—rather than gradual—technological progress.

### The High Cost of Common Sense

By any standards, manufacturing plants in this country have achieved an extremely high rate of output per worker or per dollar of equipment investment. There is, however, a strong limitation on further advances. Up to date, emphasis has been placed on the solution of manufacturing problems by empirical means—indeed, nearly all of American industry is committed to the empirical approach.

An economy based on trial-and-error technology must necessarily progress slowly. American industry has reached the point of diminishing returns so far as trial-and-error engineering is concerned. The production challenges of the next 25 years—the development of real innovations that can cause American industry to run, rather than crawl, toward a really significant increase in productivity and efficiency—must be met through the application of science and sound engineering to manufacturing on a broad scale.

Manufacturing engineers themselves are frequently unaware of the contributions that a basic engineering or scientific approach can make in their own plants. Many engineers sincerely believe that almost any manufacturing problem can be solved by what they refer to as "common sense." And yet, beyond a certain point, common sense—which usually involves taking a practical, empirical look at a problem—has severe limitations. For example, the fact that all matter is composed, ultimately, of sub-



atomic particles defies common sense, yet studies of these particles are fundamental to a real understanding of engineering materials.

Similarly, many of the breakthroughs in manufacturing technology are not at all "common sense." It is only common sense to think that as cutting speeds increase, tool temperatures increase indefinitely, yet, to take one example, experiments at Lockheed, in which materials were cut at speeds up to 200,000 fpm, have conclusively demonstrated that, beyond a certain speed, tool temperatures decrease rather than increase. This phenomenon can be predicted mathematically, as can many other aspects of the machining process. Such work, which is based on general scientific principles rather than empirical or cut-and-try findings, is capable of casting a new light on manufacturing problems—a light which common sense tends to obscure. Science, then, is a pathway to industrial progress.

**The progress of American industry during the next 25 years depends on industry's ability—and willingness—to knock out the obstacles that hinder radical improvements in manufacturing efficiency.**

### Education for Innovation

There are several roadblocks in the pathway to manufacturing progress through science. One of the largest of these is the fact that the percentage of tool and manufacturing engineers who have had formal academic training in the sciences—particularly those sciences that are applicable to manufacturing—is too small. Young people with an analytical or scientific bent have not been attracted to the field of manufacturing, where most problems have been traditionally treated as "practical" rather than scientific. And few schools have been much interested in teaching courses on manufacturing subjects—again, perhaps, because of the empirical nature of most manufacturing operations. Fortunately, this attitude seems to be changing.

Until recently, industry itself has shown no great amount of interest in manufacturing engineering education. A turning point, however, seems to have come. More and more companies are finding that they need engineers who have a substantial knowledge of the scientific aspects of manufacturing. Engineers who have been trained in other disciplines are of little use in manufacturing plants or manufacturing research laboratories until they have received a substantial amount of training along manufacturing lines. This training period costs industry time and money. Clearly, there is a real need for courses of study in manufacturing engineering in colleges and universities.

Some educators maintain that extremely broad engineering training, perhaps in mechanical engineering, best qualifies a man to enter the manufacturing field. Certainly the range of manufacturing problems is broad and a wide acquaintance with various engineering disciplines is helpful. At the same time, it should be recognized that manufacturing engineering is a highly specialized field, having the same relationship to the engineering sciences as, say, medicine has to the biological sciences.

Carrying the parallel a step further, a supply of fully qualified tool and manufacturing engineers is as important to the future economic health of America as a supply of trained physicians is to the physical health of its inhabitants.

### Selling Education to Educators

Educators are sometimes afraid that an institution that teaches a great many courses in manufacturing engineering could become a trade school. While laboratory courses in machine tool operations, metal forming and the like are desirable for many reasons, the basic content of a manufacturing engineering curriculum would, of course, deal with engineering principles, not with shop practices. Universities that maintain laboratories for chemical or nuclear research are not regarded—nor do they regard themselves—as training grounds for technicians. Neither should schools that maintain manufacturing laboratories.

Probably the first step in paving the way for the introduction of courses in tool and manufacturing engineering in colleges and universities must be taken by industry, not by educational authorities. Industry will have to convince educators that tool and manufacturing engineering deserves to be regarded as a separate engineering science. Then, too, industry will have to point out the opportunities that exist for trained tool and manufacturing engineers and specifically state that it can absorb a reasonable number of engineering graduates in this field each year. Colleges and universities, like businesses, are responsive to market demands. If there is a need for a specified number of graduate tool and manufacturing engineers each year, educational institutions will attempt to satisfy that need.

A second important step toward the introduction of tool and manufacturing curricula in America's colleges and universities is to raise the prestige of this field in academic circles. Through the medium of on-campus conferences between industry and educational leaders, ASTME is performing a trail-blazing job in this area. While the Society has made a step in the right direction, the big job must be done by industry itself. One possibility is for industry to give financial support to tool and manufacturing engineering education by sponsoring manufacturing research projects on college campuses. This would help to interest educators in manufacturing, and this interest would doubtless be a lasting one, once educators were made to see the potential for making major contributions in the field. Exciting this interest is another step toward long-term manufacturing progress. Here too, ASTME, with its research grants, has taken some trail-blazing steps in the right direction. But no engineering society or group of societies can handle this big job alone. Industry support is vital.

### Selling Education to Students

How can students be made to visualize the fascination and rewards of a career in manufacturing? Other fields—automotive engineering, aeronautical engineering, for example—have more glamour for most teen agers. Here again, ASTME has done much—through the sponsorship of student chapters and on-campus conferences—to familiarize students with manufacturing engineering. But the brunt of the task of enlisting potential engineers in the manufacturing camp will have to be borne by industry. Summer or part-time employment of engineering students in manufacturing plants is one partial answer. Talks by leaving tool and manufacturing engineers and industry leaders at colleges and universities are another partial answer. Perhaps the basis for an interest in manufacturing could be started in every community by arranging for grade school children to visit local manufacturing plants. Films for showing to PTA groups could interest parents in manufacturing as a career for their children. Salesmanship is needed—even the best product can't sell itself unless people know about it.

Ultimately, the major factor in convincing young people that their future lies in the field of manufacturing is for industry itself to provide tangible rewards to manufacturing engineers. Salaries and working conditions that are commensurate with professional status and attainments are, of course, important. Even more important, perhaps, is the provision of operating budgets that allow serious long-term manufacturing planning and research. Too often today's manufacturing engineers must spend much of their time solving day-to-day crises on the production floor.

One of the major factors in the job satisfaction of any professional person is the feeling that his training and capabilities are being fully and intelligently utilized. This feeling of accomplishment creates high-morale—morale that in itself generates enthusiasm for the profession. This feeling rubs off on students who come in contact with professional people and would certainly have a wholesome effect on manufacturing progress.

### Research for a Revolution

Ultimately, the degree of innovation—hence of manufacturing progress—depends on basic scientific research in the manufacturing area. Traditionally, the relationship of the manufacturing industries to science has been a somewhat parasitic one. Although industry has applied the findings of science, it has not, to any great degree, sponsored basic scientific research that is applicable to manufacturing. The amount of money that all the private companies in the United States spend on truly basic scientific research in the manufacturing field

is probably less than the advertising budget for one of the major cigarette companies.

With few exceptions, recent breakthroughs in manufacturing technology, breakthroughs that can be exploited by most of industry, have been made as a result of research sponsored by the military services. Numerical control, possibly the leading breakthrough of recent years, was, from its inception, developed and applied with Air Force funds. Explosive forming and ultrahigh-velocity machining, two other recent breakthroughs, are primarily the result of Air Force sponsored research and development. Much of the research and development associated with the grinding and shaping of the superalloys and, for that matter, the development of the superalloys themselves, has been financed by the government. Ceramic cutting tools, too, were first successfully developed and applied under military sponsorship.

While military necessity has been the impetus behind this work and has pushed these new developments along at a fast rate, it is entirely possible that they would have been conceived and put into action years earlier if the manufacturing industries had given greater support to basic research, both in their own plants and through the medium of industry-wide programs.

Military-sponsored manufacturing research has had an effect that goes beyond its direct contribution to technology. It has shown what can be accomplished when sufficient funds and scientific and engineering talent are put to work on specific problems. It is doubtful, however, if American industry can advance along a broad front on the basis of military-sponsored research. The manufacturing problems connected with the fabrication of a guided missile are not necessarily of vital interest to companies that make consumer products or even other types of military hardware.

### Should Uncle Do It All?

Russia, our chief military—and someday chief economic—competitor, has large government institutes devoted to manufacturing research in the fields of automation and machine tools and the work done in these institutes has accelerated Russian industrial expansion. In this country, for better or for worse, the Government has entered the field of manufacturing research and the formation of a national institute for manufacturing is certainly within the realm of possibility. Whether it is probable or not will be determined by the ability and willingness of American manufacturing industries to devote more of their time, attention—and money—to basic manufacturing research.

Since the American economy is a competitive one, most successful companies during the next 20 or 25 years will probably owe a considerable part of that success to advanced research, in both the product and manufacturing areas. And these successful companies will not sit back and wait for Government research reports—they will perform or sponsor their own research.

It can be argued that large companies have a considerable advantage over small companies so far as the amount of money they are able to allocate to manufacturing research is concerned. These smaller companies, however, are able to benefit from the research performed by larger companies. A new machining process developed by a machine tool builder, for example, or a new control developed by a control maker, can be applied by any company, large or small. With respect to basic research, the smaller company may be at a disadvantage. Still, it is surprising how many innovations in manufacturing could be—and sometimes are—performed with a minimum amount of investment and manpower. The basic equipment for explosive forming research is, after all, merely a concrete-lined tank of water and a stick of dynamite. The raw material of research is ideas—and larger companies have no monopoly on ideas.

Research requires more than an investment in facilities and time. The basic research investment is one in people. A company that wants to develop ideas and innovations that lead to profits must necessarily build a staff that is capable of making significant contributions over a long period of time.

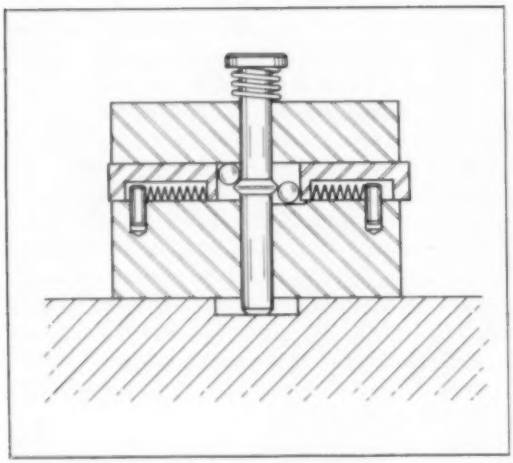
It should be mentioned, too, that the volume and importance of research results is unpredictable. By definition, research is a voyage into unknown areas of knowledge. It is comparable to explorations for new oil fields—many costly dry holes are drilled but when a new gusher comes in, the rewards are great.

Attitudes are something else again. Ideas mean nothing until they are put into action. It takes courage for companies—large and small—to back their ideas with development dollars. Nevertheless, more and more companies will do just that during the next several decades. Investment in research and development may be something of a gamble so far as any one project is concerned. Smart companies hedge their bets by undertaking several projects. This may still be a gamble but any company that is not prepared to gamble in this way is creating long odds against its own survival in a competitive world.

It can be confidently assumed that the necessary prerequisites for manufacturing progress discussed in this article will be met during the next 25 years and that a real revolution in manufacturing will take place. The pathways to progress are clearly defined. If so, what will the plant of the future be like? What will be the role of tool and manufacturing engineers 25 years hence? These subjects will be discussed in Part 2 of this article, appearing in the June issue.

# Gadgets

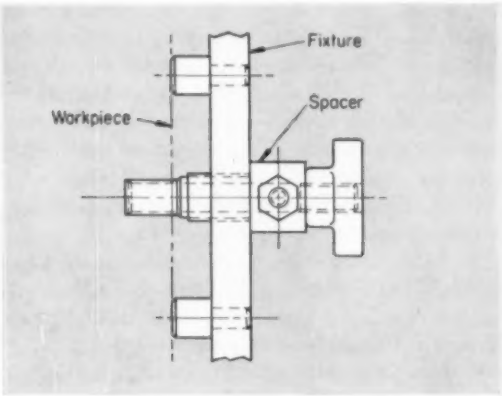
Ingenious Devices And Ideas



## Pin Gage Checks Depths to Within 0.002 Inch

Designed for close-tolerance inspection, this pin gage provides visual inspection accurate to 0.002 inch. Readings are obtained by interpreting the relative positions of two spring-loaded arms. Movements of the arms are effected by manually depressing the pin to the bottom of the hole or keyway being measured. At depths several thousandths less than acceptable, both arms project an equal amount. At depths within the acceptable tolerance range, the right arm moves out and the left retracts. If depth exceeds the prescribed tolerance range, both arms retract simultaneously.

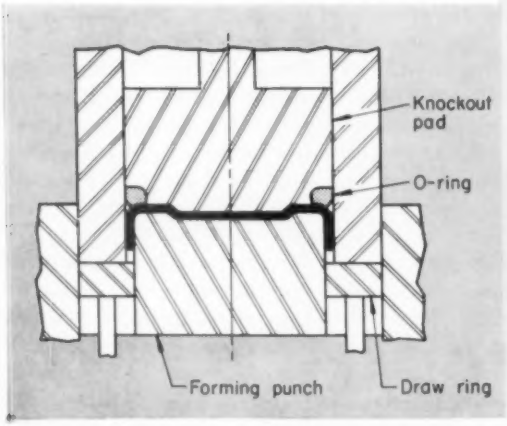
*Clint McLaughlin*
*Rockaway, Queens*
*New York, N. Y.*




## Collet Device Holds Fixture

An expanding collet fitted into a reamed hole is utilized to anchor a small fixture to a large workpiece in this design. Other essential components are a hand knob, spacer and drawbar. The drawbar, threaded at one end and tapered at the other, expands the collet, securing it in the hole. Subsequent tightening of the hand knob secures the fixture. In tests, this device has shown an ability to support axial loads of 150 lb.

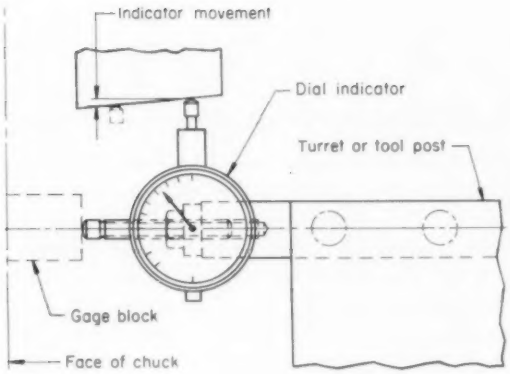
*B. Michael Coch*
*Toledo, Ohio*




## O-Ring Knockout Strips Stampings

Knockout punches used for embossing in compound blanking and drawing dies are sometimes ineffective in completing their stripping operations. Adaptation of a rubber O-ring to the knockout can effectively eliminate these problems, regardless of emboss size. Held in position by a groove in the knockout, the ring is compressed during embossing, after which its compressive pressure removes the finished part.

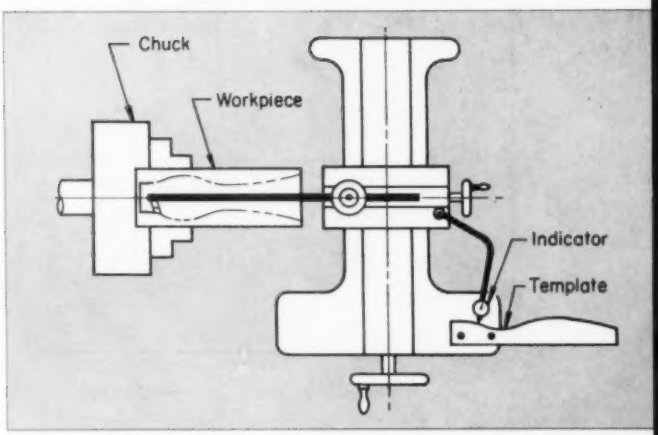
*N. Schwartz*
*Lynbrook, N. Y.*




## Indicator Assembly Checks Taper

Consisting of an indicator, setscrew, locknut and steel bar, this device enables lathe operators to check tapers without removing the workpiece from the machine. In use, a setscrew is brought in contact with gageblocks of appropriate length and the indicator is adjusted to "zero." The gageblocks are then removed and the indicator is advanced until the setscrew contacts the chuck. The increase in the indicator reading is divided by the gageblock length to obtain the tangent of the angle of taper.

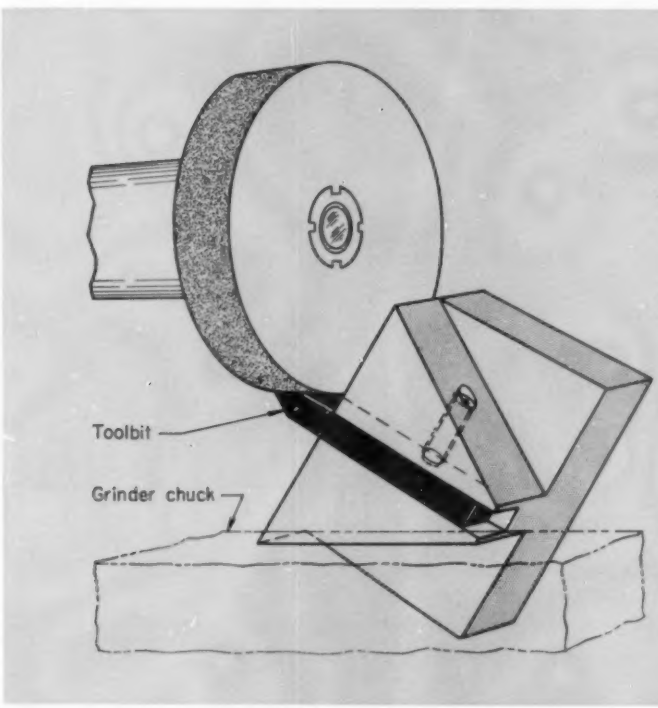
*Roger Isetts*
*Kenosha, Wis.*




## Template Setup for Bored Holes

Irregular contours in bored holes can be finished with this template setup. Machining is accomplished by manually coordinating the movements of the cross and compound feeds. Coordination of these feeds is obtained by visual guidance of a stylus against the template. Use of an indicator as a stylus enables the operator to obtain a perfect configuration.

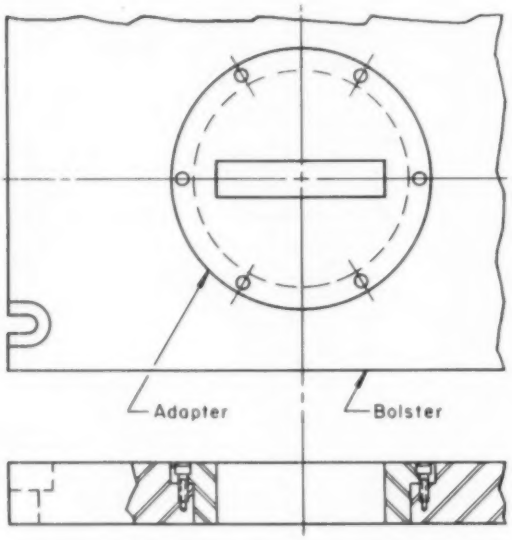
*John M. Breen*
*Pittsburgh, Pa. Chapter*




## Fixture Simplifies Tool Bit Sharpening

Tool bits for threading—often ground and sharpened manually—can be surface ground accurately and in a minimum of time with this fixture. Setup consists of positioning the tool bit in a ground slot and securing it with a set screw. The fixture is then placed on the rear edge of the chuck for exact tool bit positioning.

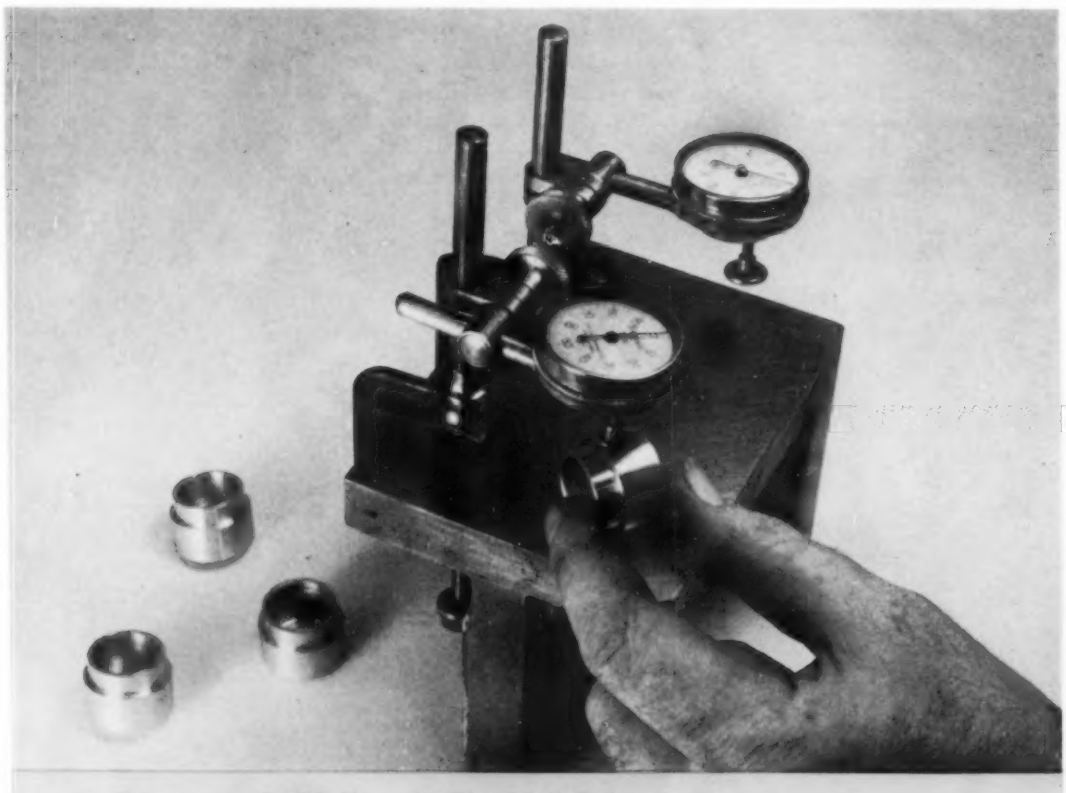
*Henry E. Piltz*
*East Orange, N. J.*




## Bolster Adapter Supports Small Dies

Designed to lend increased support to small dies, this bolster-hole adapter can be removed when large openings are required. Before the adapter can be made, however, the drop-through hole must be counterbored. The adapter can then be turned, fitted and bolted in position. To insure correct radial positioning—mandatory because the plate and adapter are ground at assembly — at least one, preferably two, dowel pins should be used.

*M. W. Loftus*
*Chicago, Ill.*

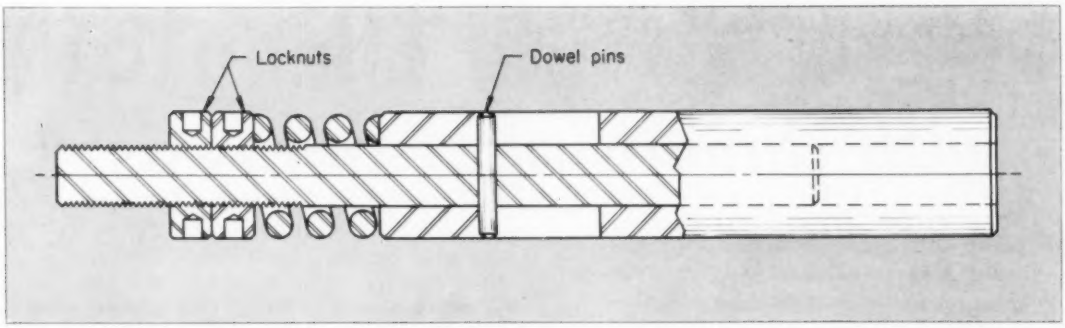


## Improvised "No" and "No-Go" Gage

**An inexpensive "go" and "no-go" gage can be improvised with two dial indicators as shown in this illustration. Mounted on an angle plate or other equally flat surfaces, the indicators can be set to preselected dimensions with gage blocks.**

***H. J. Gerber, Member-at-large***
***Stillwater, Okla.***

# Gadgets

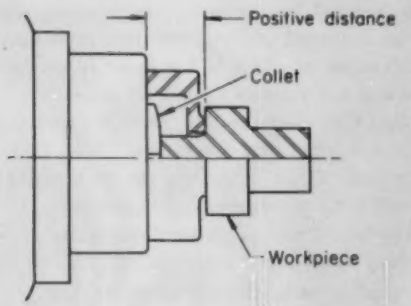



## Adjustable Pins Aid Draw Operations

Two draw dies with unequal pad movements can be set in the same press when adjustable pressure pins of this design are used. Placed in the die having the longest pad travel, the pins provide initial draw pressure with their springs. When continuing die closure causes spring pressure to equal air cushion pressure, the entire pin begins to move.

Another use of adjustable pins is found in forming pads that require uneven draw pressure as an aid to plastic flow. In these instances a number of adjustable pins can be utilized to provide prescribed imbalance.

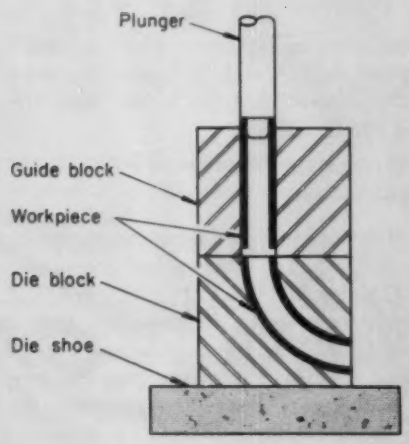
*Luther H. Bobbitt*
*Toledo, Ohio*




## Special Nosepiece Positions Parts

Because of their inability to locate parts in relation to carriage stops with repetitive accuracy, collets are somewhat restricted in performing secondary turning operations. This nosepiece is designed to eliminate that difficulty. Positioned against the spindle nose and workpiece shoulder, it insures positive and uniform spacing throughout the operation.

*K. L. Schlesinger*
*Hollywood, Calif.*




## Die Produces Curved Tubing

Tube elbows which are required in production quantities can be produced by pressworking in dies of this design. Basic components are a die block, guide and plunger. In operation, the tubular blank is placed in the guide and forced through the die block by the action of the plunger. Subsequent part ejection is effected by the advance of the next part.

*Frederico Strasser*
*Santiago, Chile*

# exploring METALCUTTING PHENOMENA with dimensional analysis

**By Max Kronenberg**
**Consulting Research Engineer**
**Cincinnati, Ohio**

**Using dimensional analysis, a mathematical technique, it is possible to obtain a better understanding of the metalcutting process without lengthy experiments. This approach has already yielded a new insight into ultrahigh-speed metalcutting phenomena and it is equally applicable to everyday machining. This article and the following one are based on talks to be presented at the 1961 ASTME Engineering Conference.**

MANUFACTURING PROGRESS depends, to a large degree, on obtaining a better understanding of metalcutting phenomena—an understanding that has traditionally been based on the results of machining tests. This empirical approach has undoubtedly hindered the advance of metalcutting science, because tests are costly and time-consuming. The need for testing can be minimized by applying dimensional analysis to metalcutting problems.

The term "dimension" as used here does not refer to the diameter of the workpiece or to tolerances, but to the physical quantities of length, mass, time and temperature. Applying dimensional analysis to metalcutting relationships such as the change in tool life with cutting speed, answers can be obtained in some cases without tests, in other cases, with only a few tests.

Dimensional analysis is based on the fact that the quantities represented by two sides of an equation must have the same dimensions, rendering it possible to determine equations connecting physical quantities by considering only the dimensions of the quantities involved, without a detailed theory.

**Sample Problem:** A typical problem that can be explored by dimensional analysis is the effect of cutting speed and chip cross sectional area on the mean temperature at the tool-chip interface when no cutting fluid is used. Although dimensional analysis has some built-in features that would prevent conclusions from entirely wrong assumptions, some judgment is needed in determining the significant factors that may affect this relationship. It may be assumed, however, that the quantities listed in the accompanying table are of prime importance to the problem. The table shows the physical quantity, the symbol used for representing it in the equations, and the dimension of each quantity in terms of length, $L$, Mass, $M$, Time, $T$ and Temperature, $\theta$.

Definite physical-mathematical relationships must exist between these quantities, according to the law of dimensional homogeneity, which states that all terms in a correct physical equation must have the same dimensions. This is the same as saying that apples and automobiles cannot be added.

In the table, there are six physical quantities ($t$, $A$, $v$, $p$, $w$, $h$) and four dimensions ($L, M, T, \theta$). In such a case, all six quantities can be brought into relationship by two dimensionless quantities, $Q_1$ and $Q_2$. Any five of the six physical quantities are used in writing equations for $Q_1$ and $Q_2$. An exponent is assigned to each physical quantity. Thus:

$$Q_1 = (v^a)(p^b)(w^c)(h^d)(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Q_2 = (v^e)(p^f)(w^g)(h^i)(A) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The exponents in Equations 1 and 2 must be so determined that $Q_1$ and $Q_2$ become dimensionless. First the dimensions given in the table are substituted into Equation 1:

$$Q_1 = (L^aT^{-a})(M^bL^{-b}T^{-2b})(M^cL^cT^{-2c}\theta^{-c})$$
$$(M^dL^{-d}T^{-2d}\theta^{-d})(\theta)$$

Now all factors with $L$ dimensions are multiplied, giving $L^{a-b+c-d}$. The same method is applied to $M$, $T$ and $\theta$, giving $M^{b+c+d}$, $T^{-a-2b-2c-2d}$, $\theta^{-c-d+1}$.

In order to make $Q_1$ dimensionless, these exponents of $L$, $M$, $T$, and $\theta$ must become zero. Four equations with four unknown quantities are obtained in this way. From these equations, the following values for the exponents are derived: $a = 0$; $b = -1.0$; $c = 0$; $d = +1.0$. Substituting them

into Equation 1, the value for $Q_1$ is obtained.

$$Q_1 = \frac{(h)\,(t)}{p} \quad \ldots\ldots (3)$$

In the same way, the dimensionless value for $Q_2$ is derived:

$$Q_2 = \frac{(v^2)\,(h^2)\,(A)}{W^3} \quad \ldots\ldots (4)$$

**Some Results:** Exploration of the dimensionless factors $Q_1$ and $Q_2$ gives some new clues as to the behavior of metals during machining. Considering the term $w^2/h^2$, which appears as a reciprocal in Equation 4, for example, it is evident that it is composed of the heat conductivity, $w$, of the work material, and the product of specific heat, $c$, and specific gravity, $\sigma$. The ratio $w/h$ is, therefore, the ratio of heat conductivity and the specific heat per unit volume of metal removed. This is the ratio that is known to metallurgists as the thermal diffusion coefficient.

The chip cross sectional area, $A$, is also included in Equation 4. This leads to the conclusion that the time of relaxation for the establishment of temperature equilibrium in cutting is involved in the dimensionless quantity $Q_2$. The time of relaxation is the ratio of the area through which heat must flow for establishing temperature equilibrium and the thermal diffusion coefficient. It would be beyond the scope of this article to go further into the relaxation time problem in metalcutting, but the need for research in this direction is clearly indicated by dimensional analysis.

In view of the fact that the specific heat per unit volume of metal removed, $h$, appears in $Q_1$, it can be concluded that the product of the terms $w$, $c$ and $\sigma$, rather than their ratio, is involved in $Q_1$. This, too, casts light on the metalcutting process.

To derive an equation for tool temperature, a relationship between $Q_1$ and $Q_2$ must be found experimentally by measuring cutting speed, specific force and other variables for a few cases. Tests where all of the significant quantities have been measured are rare. Data developed by Gottwein have been used in computing numerous values for $Q_1$ and $Q_2$. These are plotted below.

The relationship between $Q_1$ and $Q_2$ can be established by deriving the mathematical formula for the three straight lines shown on the figure. For the "over-all average" line,

$$Q_1 = k_0 Q_2^n \quad \ldots\ldots (5)$$

where $k_0$ is a constant indicating the magnitude of $Q_1$ when $Q_2 = 1.0$. It can be found directly from the graph by extending the straight line to the left beyond $Q_2 = 1000$ (not shown).

The relationship between $Q_1$ and $Q_2$ for the upper line (largest feed) on the graph is, accordingly:

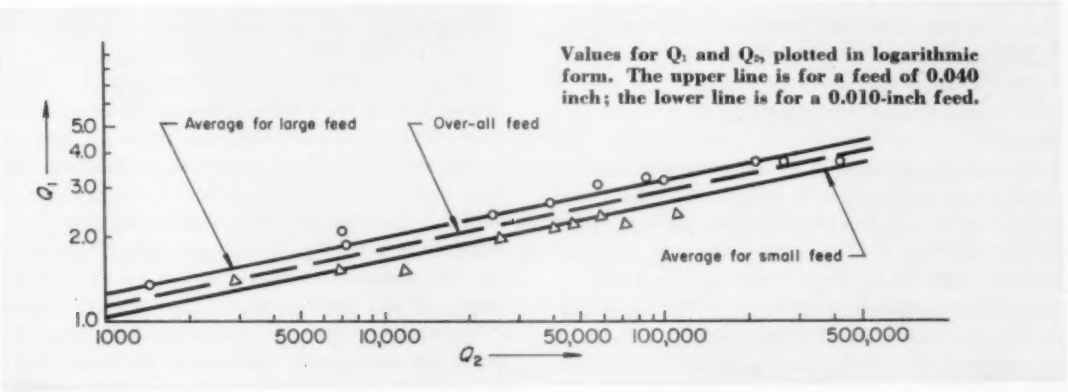
$$Q_1 = k_1 (Q_2^n) \quad \ldots\ldots (6)$$

where $k_1$ indicates the magnitude of $Q_1$ when $Q_2 = 1$. $k_1$ is larger than $k_0$ because the upper straight line will intercept the axis for $Q_2 = 1$ at a higher value for $Q_1$.

Similarly, the case of the lower line on the graph (smallest feed),

$$Q_1 = k_2 (Q_2^n) \quad \ldots\ldots (7)$$

In this case, $k_2$ is smaller than $k_0$. The exponent $n$ for the three lines is the same since they are parallels on log-log paper, and follows from their slope, which is 0.22 on the graph.




**Values for $Q_1$ and $Q_2$, plotted in logarithmic form. The upper line is for a feed of 0.040 inch; the lower line is for a 0.010-inch feed.**

The general formula correlating tool temperature, $t$, with the other five physical quantities is obtained by substituting Equation 3 and Equation 4 into Equations 5, 6 and 7. In the case of the over-all average line shown on the graph:

$$t = \frac{(k_0)\,(p)\,(v^{0.44})\,(A^{0.22})}{(W^{0.44})\,(h^{0.56})} \quad \ldots\ldots (8)$$

Equation 8 shows that the tool temperature varies approximately in proportion to the square root of the cutting speed. In other words, the tool temperature rise slows down as the cutting speed is increased. As an example, when cutting speeds are

increased to 100 times the speeds used in conventional machining, the tool temperature would increase only $100^{0.44}$, or 6.3 times. Thus the widely held theory that tool temperatures rise at the same rate as cutting speeds is incorrect, according to dimensional analysis. The slow rise of tool temperature with cutting speed is supported by tests carried out at Massachusetts Institute of Technology, where an exponent of 0.5 was found for cutting speeds. The general agreement between the prediction based on dimensional analysis and the MIT findings, which were developed by an entirely different method, can be taken as proof of the significance of dimensional analysis for metalcutting problems, and also as proof of the validity of the results obtained at MIT.

Equation 8 shows that the tool temperature rises (approximately) with the fourth root of the chip cross sectional area, that is, at a considerably slower rate than the cutting speed.

The upper and lower lines on the graph permit a refinement of Equation 8 showing the effects of feed and depth of cut on cutting temperatures. The ratio of the constants $k_s$ and $k_1$ is used. By extrapolation of the two lines on the graph, the ratio is found to be 0.84:1. Since the lower line refers to a feed of 0.010 inch and the upper line to a feed of 0.040 inch, the feed ratio is 0.25:1. In order to express the ratio of the two $k$ constants in terms of the feed ratio, the exponent of the feed ratio is determined as follows: $0.25^x = 0.84$; hence $x = 0.127$. This indicates that the feed can be included in Equatiton 8 by simultaneously introducing a new constant, $k_2$. The revised equation is:

$$t = \frac{(k_2)\,(p)\,(v^{0.44})\,(d^{0.22})\,(f^{0.347})}{(w^{0.44})\,(h^{0.56})} \qquad (9)$$

Equation 9 shows that the effect of the feed, $f$, on the tool temperature is greater than the effect of depth of cut, $d$. Doubling the feed produces a 27 percent ($2^{0.347} = 1.27$) increase in tool temperature. Doubling the depth of cut produces a 17 percent increase in temperature ($2^{0.22} = 1.17$). Doubling the cutting speed gives a 36 percent increase in tool temperature ($2^{0.44} = 1.36$). Equations 8 and 9 also show that the unit cutting force, $p$, has the greatest effect on tool temperature, due to the fact that its exponent is 1.0. The unit cutting force is dependent on the tensile strength of the work material, tool geometry and other factors.

**Physical Quantities and Dimensions**

| Physical Quantity | Symbol | Dimension |
|---|---|---|
| Temperature | $t$ | $\theta$ |
| Chip cross sectional area | $A$ | $L^2$ |
| Cutting speed | $v$ | $L/T$ |
| Unit cutting force | $p$ | $M/LT^2$ |
| Thermal conductivity of work | $w$ | $MLT^3\theta$ |
| Volume specific heat ($cQ$) | $h$ | $M/LT^2\theta$ |

In Equations 8 and 9, the heat conductivity, $w$, and the specific heat per unit volume of metal removed, $h$, do not appear as a ratio as in the case of the thermal diffusion coefficient, but as a product with nearly equal exponents. In this regard, too, the findings from dimensional analysis agree with the MIT test results.

**Other Applications:** The preceding example shows how dimensional analysis can be employed to shed new light on the metalcutting process. Dimensional analysis can also be used to derive the Taylor Equation for the relationship between tool life and cutting speed. The derivation of the Taylor Equation in this way leads to the conclusion that the equation applies to constant temperature and will not necessarily hold when the temperature, the unit cutting force, the chip cross sectional area and the consolidated heat value vary. Going a step further, a generalized Taylor Equation has been developed by dimensional analysis. This equation indicates that tool life may increase with increased cutting speed—a finding that was confirmed during ultrahigh-speed machining tests run at Lockheed Aircraft Corp. in consultation with the author.

Dimensional analysis shows that tool life may vary with the eighth to the twenty-third power of temperature. This finding, too, is confirmed exactly by test data published in the *Tool Engineers Handbook*.

Several other interesting conclusions concerning the metalcutting process have been reached through dimensional analysis. For example, dimensional analysis shows that a new tool material that could endure a 10 percent higher increase in temperature than existing tool materials would have 160 percent longer life. Also, dimensional analysis predicts that tools heat up quickly during the first few seconds of cutting. Then the rate of heating slows down substantially. A tool may heat up to 615 F during the first quarter-second of cutting. A further increase of 615 degrees would require eight hours.

The examples given are sufficient to illustrate the power of dimensional analysis to shed new light on metalcutting phenomena without prolonged testing and the ability of this method to suggest areas where research will prove fruitful. Through research of this kind, aimed at discovery of the basic principles of metalcutting, it may ultimately be possible to predict the performance of cutting tools, eliminating present-day hit-or-miss methods.

This article is based on ASTME Paper 331, "Ultra High Speed and Other Metal Cutting Phenomena Explored by Dimensional Analysis," to be presented at the 1961 ASTME Engineering Conference. Copies of the complete paper, which contains the complete derivation of the Taylor Equation by dimensional analysis and other examples of the applications of this technique to metalcutting problems, are available for purchase from Society headquarters.

# how to improve
# TRACER LATHE ACCURACY
## Part 2—Lathe Check

**By J. Bryan, J. Bowerbank, E. Holland, O. Mohl**

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**University of California**
**Livermore, Calif.**

**Methods developed by the authors make it possible to pinpoint the sources of machining error in tracer lathe operations. Once the sources of error are found, corrective modifications can be taken, with consequent improvement in machining accuracy and reliability.**

WITH THE DEMAND for greater machining accuracy, there is a real need for a method to locate and determine quantitatively the errors of tracer lathe machining. Such a method has been developed by the University of California Radiation Laboratories. This method provides data on first-order errors. Second-order errors are not significant.

Checking is divided into six steps. The first check, covered in Part 1 of this article, provides data on the composite nonlathe machining errors. The remaining checks, which provide data on the lathe operating error, are the twin disk check, the single disk check, the spindle check, the template carrier check and the slides check.

**Twin Disk Check:** The twin disk check measures how accurately the lathe servo system and the lathe slides operate to regenerate the template bearing surface path at the tool compound. Some of the servo system errors and slide errors may be additive, some compensative. The error measured by the twin disk check is the composite error of the servo system and slides that will appear when a half disk template is used. To avoid overlooking some compensative errors that may occur when using one template shape, two pairs of half disk templates, one male and one female, are used. The disk shape is selected because it is easy to make, easy to measure, and puts the servo system through crossover and varying speeds.

Either the male or the female templates may be used for the first twin disk check. One half-disk, the master template, is placed on the lathe template carrier. The other, the work template, is positioned at the lathe spindle. Some suitably accurate linear measuring device is placed in the position of the tool at the pole of the work template. As in the part check, the measuring device stylus should have the same radius as the lathe servo transducer stylus, and it must be able to operate within its accuracy tolerance with the sensitive axis as much as 45 deg from the measured axis.

The templates must be properly oriented; that is, the lines from the centers of the templates to the points of bearing surface contact of the respective stylii must be parallel. This can be done by successively adjusting the templates until the pole reading is the same as the equator reading. This usually requires only a few adjustments. The accuracy obtained is limited by the type of indicator used. If the template carrier has $X$-$Y$ adjustments, it is probably easiest to make rough adjustments on the work template and fine adjustments at the template carrier. The adjustment will, of course, not be perfect. The setup is shown in *Fig.* 1.

To eliminate the residal adjustment error, the results of a twin disk check should be charted and the ends of the chart, that is, the pole and equator positions, should be connected by a base line. The twin disk check indicated error at any point is the

difference between this base line and the error curve read along the normal to the line.

This indicated error is not always the true error. When the measuring device sensitive axis is not normal to the surface being measured, the true error is a function of the indicated error and the cosine of the angle between the sensitive axis and the normal to the surface being measured. *Fig.* 2 shows this relationship for a 45-deg angular displacement of the measuring device. If the position error of the tool compound at point *O* is *A*, the measuring device will move along *B*, which is 45 deg to *A*, to measure this displacement. The true error, *A*, is then cosine 45 deg times *B*.

The base line from which twin disk check errors are measured will be a straight line only if there is no zero adjustment error; that is, only if the pole and equator readings are the same. If the zero adjustment error is small with respect to the total error, a straight line may be used. The reading error in that case will reach a maximum at the 45 deg point of 15 percent of the indicated zero adjustment error. If this is too much, a more accurate sine curve base line may be used to connect the ends of the chart. A better way, however, is to do the check over, being more careful when zeroing.

*Fig.* 1 shows the relationship of the templates, lathe, and measuring equipment for the twin disk check. As the lathe moves from pole to equator, any deviation of the measuring device from its base line position is an indication of the lathe no-load tool path error. If the no-load tool path error is all plus or all minus and is fairly even, it can be decreased to below significant levels by use of the stylus offset. Normally, the stylus offset is used to obtain uniform wall thickness. If a stylus offset is used and the tool is zeroed at the pole and equator to compensate for the stylus offset, the effect of the compensatory adjustment is to increase or decrease the radius of the cut. *Fig.* 3 shows how increasing the stylus-to-tool-radius ratio causes the tool to cut closer through the center section of the workpiece and how decreasing the stylus-to-tool-radius ratio causes the tool to cut a fatter part through the center section.

If the use of the stylus offset is not a satisfactory solution to a lathe template bearing surface regeneration error, it will be necessary to make adjustments or repairs to the lathe servo system and slides. Before doing this, it is necessary to determine the source of the error. A single disk check measures what part of the error is in the lathe servo system. A slides check measures what part of the error is in the lathe slides.

**Single Disk Check:** The single disk check measures how accurately the servo system holds the frame of the transducer to the path of the locus

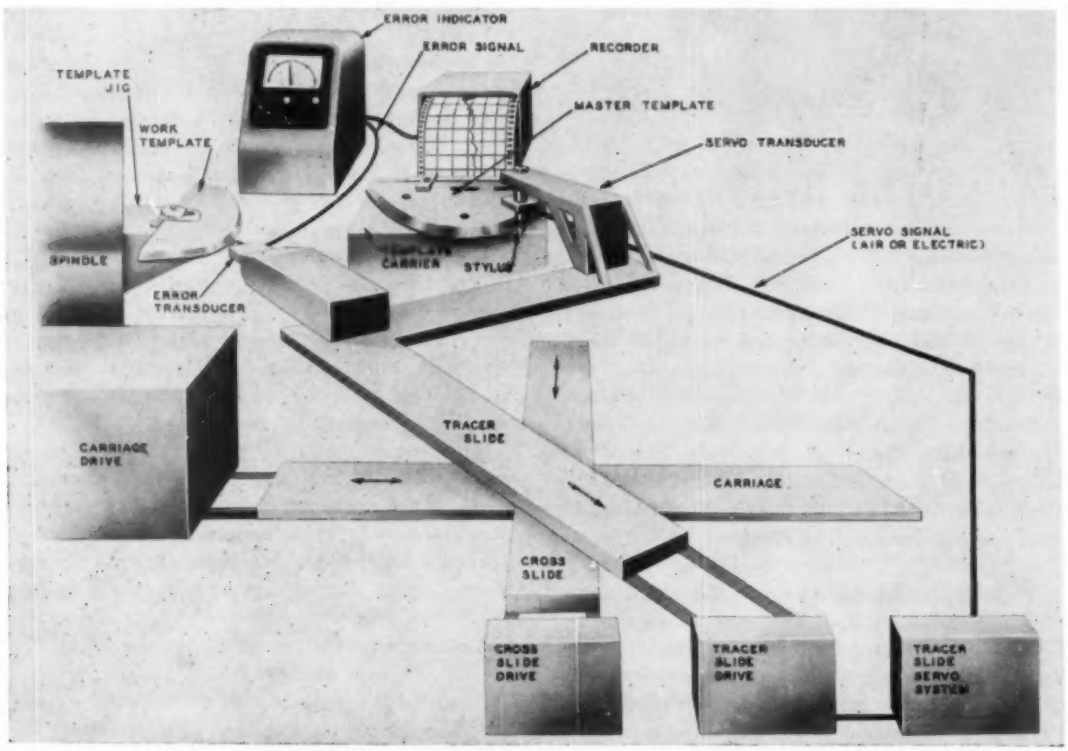



**Fig. 1. Twin disk check. Work template is compared with master template.**

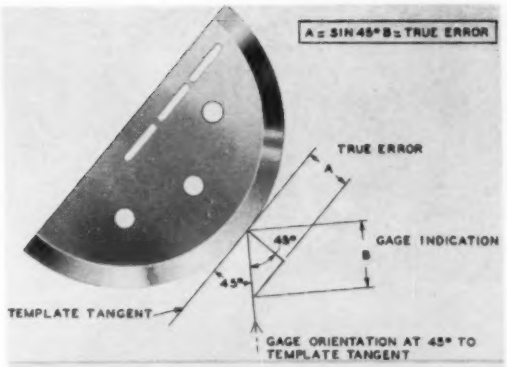



**Fig. 2. Determination of true error from indicated error.**

curve being traced by the stylus of the transducer. A servo system functions by maintaining the position of the frame of the transducer with respect to its sensitive element, or stylus. In the single disk check, the servo system operation is checked by measuring the relative movement along the sensitive axis between the stylus of the transducer and the frame of the transducer. A linear measuring device is needed to measure this relative movement. The measuring device, or gage, is normally mounted to the frame or support of the transducer so that it can measure stylus movement. The sensitive axes of transducer and gage are aligned in parallel. On some transducers, it may be necessary to attach a small plate to the stylus to give the gage a good measuring surface.

Some transducers have multi-axis sensitivity. In this case, two gages mounted with their sensitive axes 90 deg apart are needed. The gages should be oriented so that the vector resulant of their indications represents the full relative movement of transducer frame and stylus. If a single disk check is to be made with a multi-axis transducer, the gages should be mounted so that one sensitive axis is normal to the template bearing surface at the pole and the other is normal to the template bearing surface at the equator.

A transducer operates by converting the relative movement between stylus and transducer frame into a signal. This transducer signal is amplified by the servo system into a power signal, which is used to drive the tracer slide. The direction of drive moves the transducer, which is attached to the tracer slide, so that the transducer signal is canceled. This means that some small movement between stylus and transducer frame is needed to make the servo system operate. The greater the stylus-transducer frame displacement, the greater will be the servo system drive speed.

If the stylus deflection versus tracer slide servo system speed curve is known, the expected stylus deflection curve for a given feed speed and template can be plotted. This curve then is the result to expect from a single disk check if the servo system is operating properly. Deviations from the plotted stylus deflection curve indicate faulty servo system operation. A number of servo system troubles could produce deviations in the single disk check stylus deflection curve. Dirty oil or filters, or sticky valves or pistons, could cause trouble in the hydraulic system. Low magnification or poor regulators in the amplification system could also be the causes of trouble. If an air tracer is used, the wrong size orifice, air hose leaks, or too-long air hoses could cause trouble. An error will result if a single axis transducer is not stiff enough to force all stylus pressures into movement along the sensitive axis. Poorly adjusted gibs may cause the tracer slide to stick so that excessive stylus deflection results before the servo system can drive hard enough to force the slide past the sticky spot. The different kinds of servo systems will have their particular disorders requiring different trouble-shooting methods.

The single disk check stylus deflection curve is

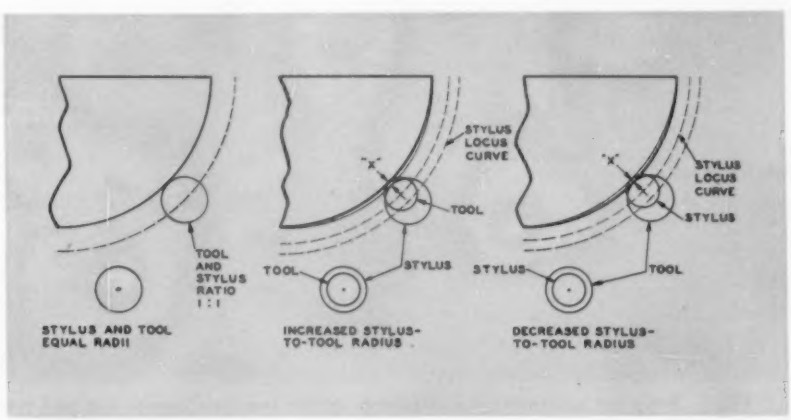



**Fig. 3. Stylus offset correction. In all cases, center of tool follows curve with same radius as locus curve traced by center of stylus.**

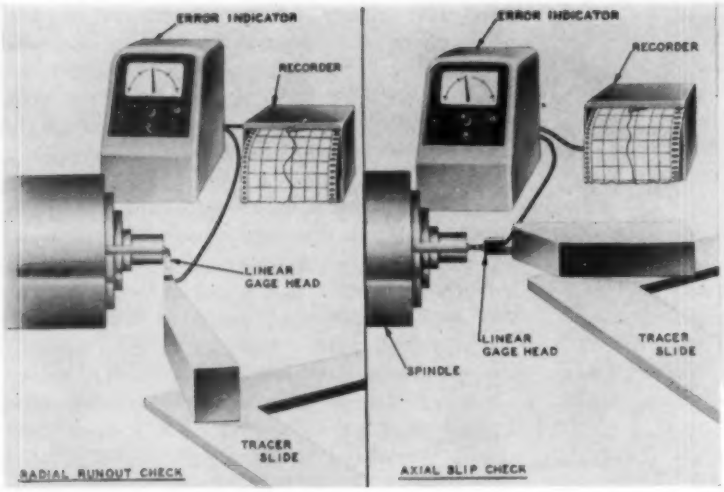



**Fig. 4. Methods for checking radial runout and axial slip of spindle.**

not the machining error caused by the servo system. Because the lathe is zeroed at the pole and equator, most of the error caused by stylus deflection is eliminated. The amount of machining error likely to result from stylus deflection can be approximated by connecting the ends of the stylus deflection curve with a straight line. The difference between the two lines at any point is an approximation of the servo system machining error likely to result at that point in the cut. From this, it can be determined whether or not a significant part of the twin disk check error is the result of faulty servo system operation.

If a significant part of the twin disk check error is in the servo system, it will be revealed by the single disk check. More commonly, however, the significant part of the composite error of a twin disk check is the result of faulty slide operation. A slides check will reveal what part of the composite twin disk error is due to faulty slide operation.

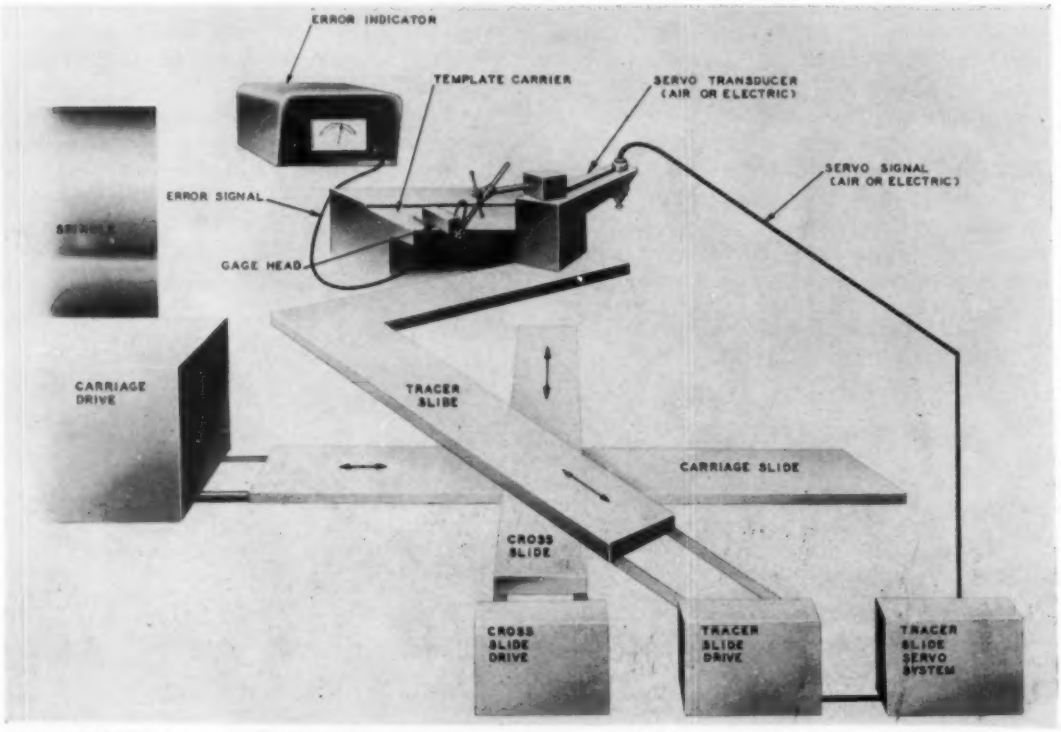



**Fig. 5. Setup for measuring the alignment of the template carrier bed and the template carrier back bar.**

**Spindle Check:** The spindle check measures spindle axis displacement. It determines whether or not the spindle has a camming action that is part of the spindle bearing and cannot be removed by chucking. An example is a lobe that occurs every 40 revolutions, which could be caused by a worn roller bearing. The spindle check measures spindle axis displacement in two directions, along the spindle axis, which is called axial slip, and normal to the spindle axis, which is called radial runout. *Fig.* 4 illustrates how these error movements are measured. The measurements are made by placing a linear measuring device against a spindle ball fixture with the sensitive axis aligned to measure either axial slip or radial runout. If a spindle does have a camming action that will result in a significant machining error, it will be necessary to rework the spindle bearing or housing, perhaps replacing parts. After spindle reworking or adjustment, it should be checked at high speed for overheating.

**Template Carrier Check:** The template carrier check measures the orientation of the template carrier with respect to the spindle axis and to the slide's plane of travel. The elliptical error resulting from a template carrier bed misalignment is a second order error, which is not significant. It is important, however, that the template lie parallel to the slides travel so the stylus will ride near the center of the template bearing surface. This is the area of the bearing surface that is inspected. If the stylus did not remain in this area, correlation of errors with template bearing surface inspection results would not be valid.

The template carrier check also determines how closely the template carrier back bar is aligned with the spindle axis. Except for circular templates, misalignment of template carrier back bar with the spindle axis will result in improper orientation of the cut with respect to the rest of the part.

A linear measuring device is used to measure the alignment of both template carrier bed and template carrier back bar. *Fig.* 5 illustrates this. Measuring the bed for alignment with slide travel along two perpendicular directions is enough. To measure the back bar alignment, a parallel bar aligned with the spindle axis is needed to measure against while the servo system stylus is riding the back bar. The parallel bar need not be aligned perfectly. The error can be determined by rotating the parallel bar 180 deg after taking the first readings and then taking a second series of readings. The two sets of readings can be analyzed to provide the alignment error.

This article will conclude with a description of the slides check in the June issue.

This article is based on a paper to be presented at the 1961 ASTME Engineering Conference. Copies of the complete paper, which includes a complete description of the lathe check equipment used and details of the procedures followed, can be purchased from Society Headquarters.

## Titanium Fittings Cold Extruded

Low-cost manufacture of titanium fittings has been made possible with precision cold extrusion techniques developed by Battelle Memorial Institute for the Manufacturing and Materials Technology Div., Air Materiel Command Aeronautical Systems Center, U. S. Air Force.

The titanium part used in a pilot run at Battelle was a No. 10 size hexagonal nut for MS type aircraft quality flareless tube fittings, normally produced in steel or aluminum entirely on automatic screw machines. Production of titanium fittings by machining has been so costly that their use has not been justified. The Battelle process has cut this cost almost in half.

Full-size hexagonal cups were backward extruded in a single operation from solid cylindrical AMS 4902 unalloyed titanium billets 1-inch diameter by $\frac{5}{8}$ inch thick. The operation involved a 55 percent extrusion reduction and required a pressure of about 335,000 psi. The hexagonal cups, measuring 1 inch across the flats by 1 inch long with $\frac{25}{32}$-inch bore, were then finish machined and threaded on a screw machine.

Not only is the starting billet used in cold extrusion only half the weight of the one needed for screw machining, but it also can be cut from round barstock instead of the more expensive hexagonal barstock. Material cost for an AMS 4902 titanium No. 10 nut produced by cold extrusion with screw machine finishing amounts to 64 cents compared to $1.52 for a nut produced exclusively by screw machining operations.

Comparing over-all manufacturing costs, preforming the nut by cold extrusion and finishing on an automatic screw machine yields a net cost saving of 48.5 percent over the conventional method of making the nut completely by screw machine methods.

In addition to significant cost savings on material and labor, the cold extrusion process also offers the advantages of (1) considerable strengthening through work hardening and (2) excellent surface finishes and close dimensional control in the as-extruded condition.

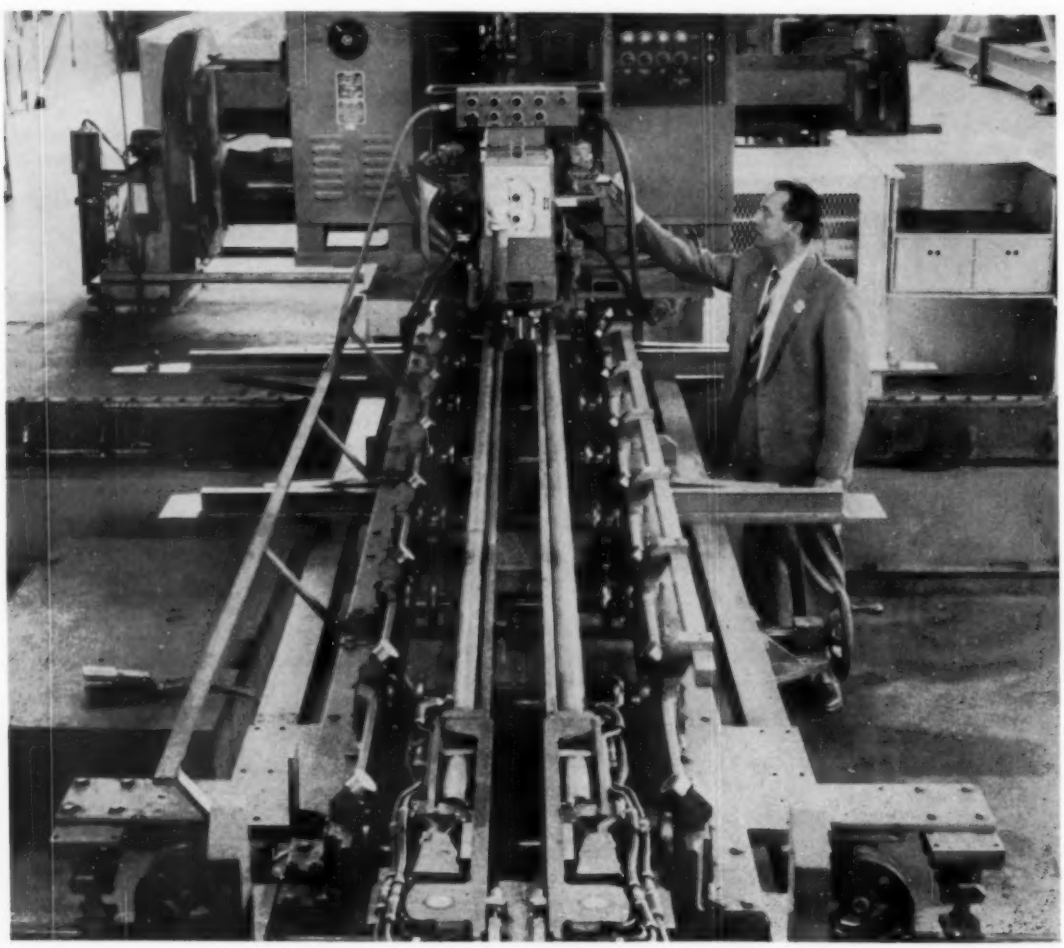
*designed for*

# PRODUCTION

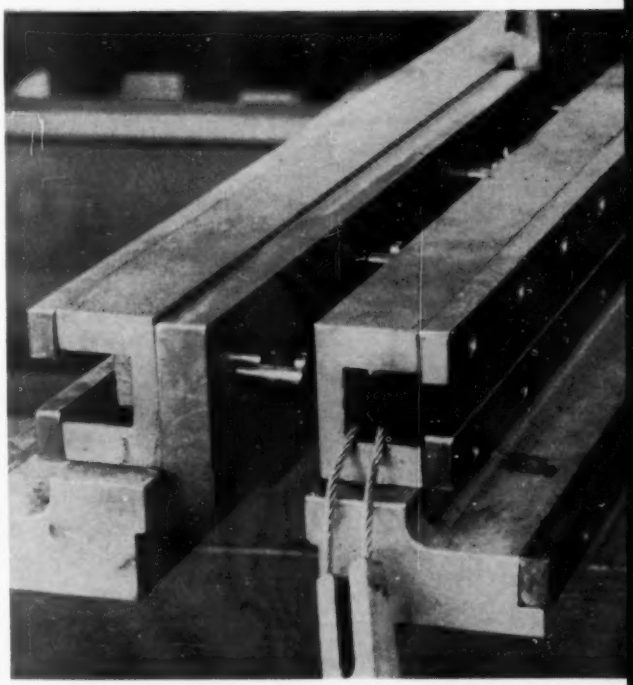
## Extended-Reach Machine Makes Blind Welds

Designed for welding operations in otherwise inaccessible locations, this machine is used in the manufacture of aircraft wings. It welds shear caps to shear webs—two basic components in the structure of the wing. Before this welding operation takes place, the shear caps are fastened to sandwich structures by conventional methods.

In setup, T-bars are inserted into the wing structure at each side of the shear web. Locking pins passing between them, and secured by wedge-lock mechanisms, provide exact alignment and the holding power necessary to withstand the pressures of



OVER-ALL VIEW of the extended-reach welder.

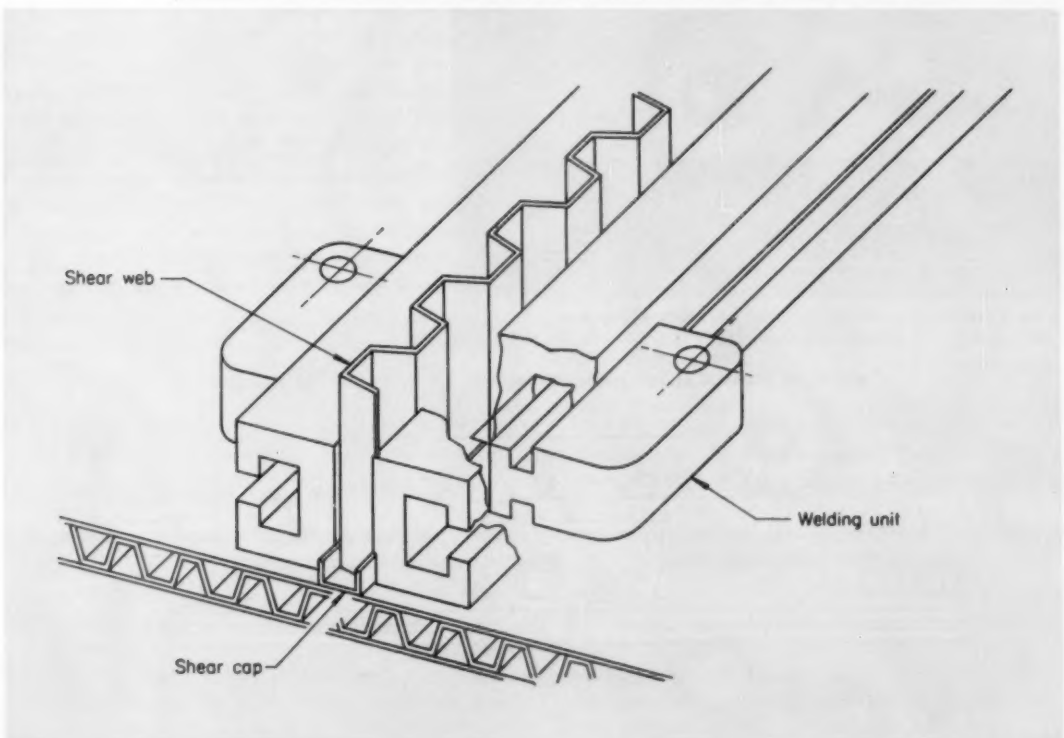


T-BARS and alignment pins for guiding the welding unit. Clamp in foreground fits over flats on pins to lock assembly.

welding. Setup is completed by mounting mobile welding units in the T-bar tracks.

The welding units, manufactured by Sciaky Brothers, Inc., are advanced from station to station on the T-bars by variable speed d-c motors. As the welders arrive at operative positions, locators on the guns are activated to register each unit in exact position for welding.

DIAGRAM of welding assembly showing workpieces, T-bars and welding unit.



# DESIGNED FOR PRODUCTION

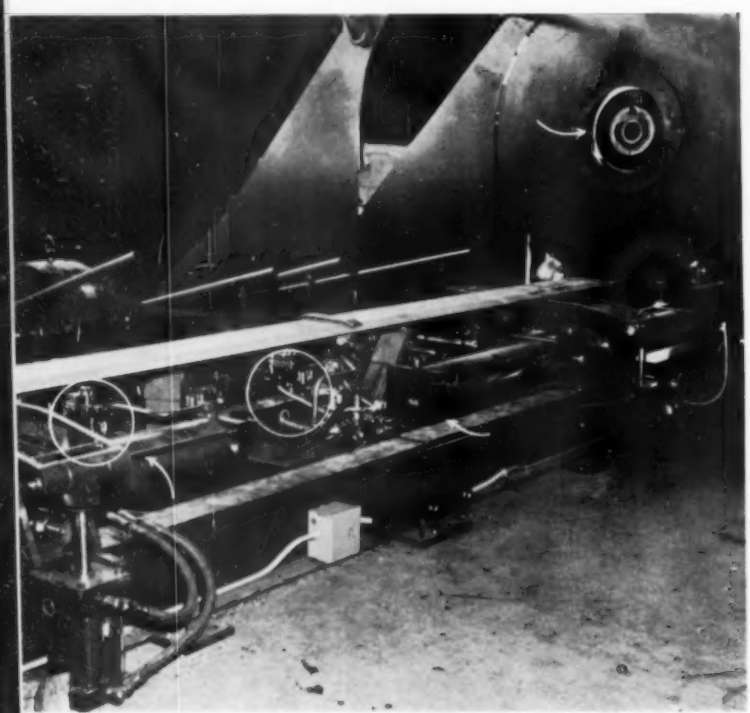
## Pneumatic Control System Activates Reel

Instantaneous in-and-out movement of winding mandrels, each weighing seven tons, is accomplished in this machine by an unusual pneumatic control system. Designed and built by National Electric Welding Machines, Bay City, Mich., the reel winds wire mesh emerging from a welding machine. The welder, not shown in the illustration, fabricates the mesh by welding individual strands of wire into desired patterns.

Rapid withdrawal of the mandrels—each weighing seven tons—must be accomplished without damaging the equipment or interrupting production at the welder.

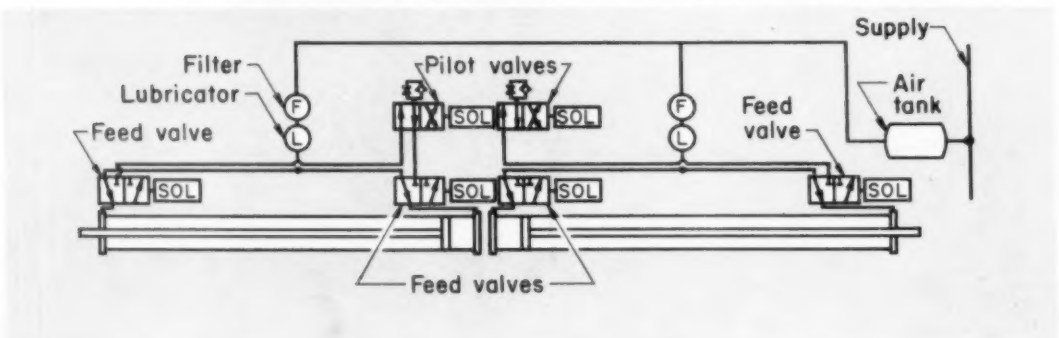
As shown in the schematic diagram, rapid acceleration and deceleration of the pistons which actuate the mandrels is accomplished by rapid bleedoff of air from the outer solenoid feed valves. These exhaust through pilot valves. As the pistons approach the ends of their strokes and a low-impact stop is required, bleedoff is shifted to the pilot valves. This permits a pressure buildup which serves as an effective brake on the advancing pistons. During return of the pistons, air bleedoff takes place through the inner feed valves into the main pressure line.

After the mandrels withdraw, the machine is unloaded by a bar that raises the rolls to exit rails. This bar is activated by hydraulic cylinders at the front of the machine.



PARTIAL VIEW of the winding reel. Right-hand mandrel, withdrawn for unloading, is indicated by arrow in upper right.

SCHEMATIC DIAGRAM of the pneumatic system for activating the mandrels.



# TRACER MACHINE
## *contours to millionths*

**By Robert Heslen**
**Associate Editor**

**New concepts of control and machine design have been combined in a contour tracing machine that is capable of maintaining extremely close tolerances in the production of missile and nuclear reactor components.**

TRACER MACHINING is a fast and inherently foolproof method for producing contoured workpieces. Its accuracy is limited by two main factors—the accuracy of the template or model and the accuracy of the machine tool and its servo system. With the demand for higher accuracy, machine tool builders and servo-control builders have consistently reduced the margin of error in tracer machining systems. Today, tracer controlled machines that are capable of reproducing the contours of a master within tolerances of millionths of an inch are in production use.

One such machine, *Fig.* 1, holds the thickness of the "error envelope"—the bandwidth of tolerance error at the surface of the workpiece—to 0.000300 inch for contoured workpieces and to ±0.000100 inch for plane workpieces. The slight inaccuracies are contributed by the tool slides, tracer head, tool pressure variation, vibration and other variables. It is, of course, impossible to eliminate some degree of fluctuation in these variables, but fluctuations are kept to a minimum by the machine design. The machine slides, for example, are mounted on precision bearings to minimize error and friction. Deviation measures only 0.000030 inch over a 32-inch slide length. The table shows somewhat less than 0.000050 runout on its face and OD

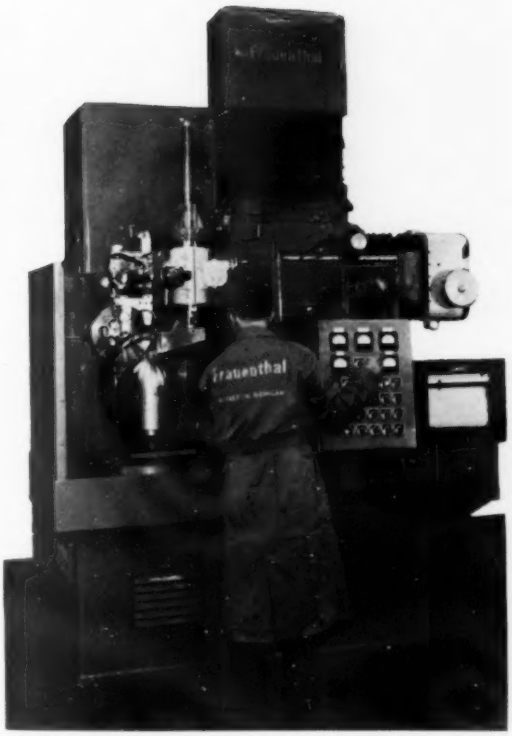



**Fig. 1. Stylus deflection as it follows disk template is used to generate hemispherical workpiece. Errors in tracing are simultaneously plotted on recorder (at right, on machine).**

Errors in the Minneapolis-Honeywell electrohydraulic tracer system measure only 0.000020 inch in a typical plot. The system operates on a 0.010-inch nominal stylus deflection—a constant bias taken into account when the tool is aligned with the tracer head. The servo system acts to maintain the 0.010-inch deflection.

Since precision is desirable in the atomic components produced by this Frauenthal contouring machine, close attention is paid to variables affecting reproduction accuracy. At the outset, the template is produced as accurately as possible on a

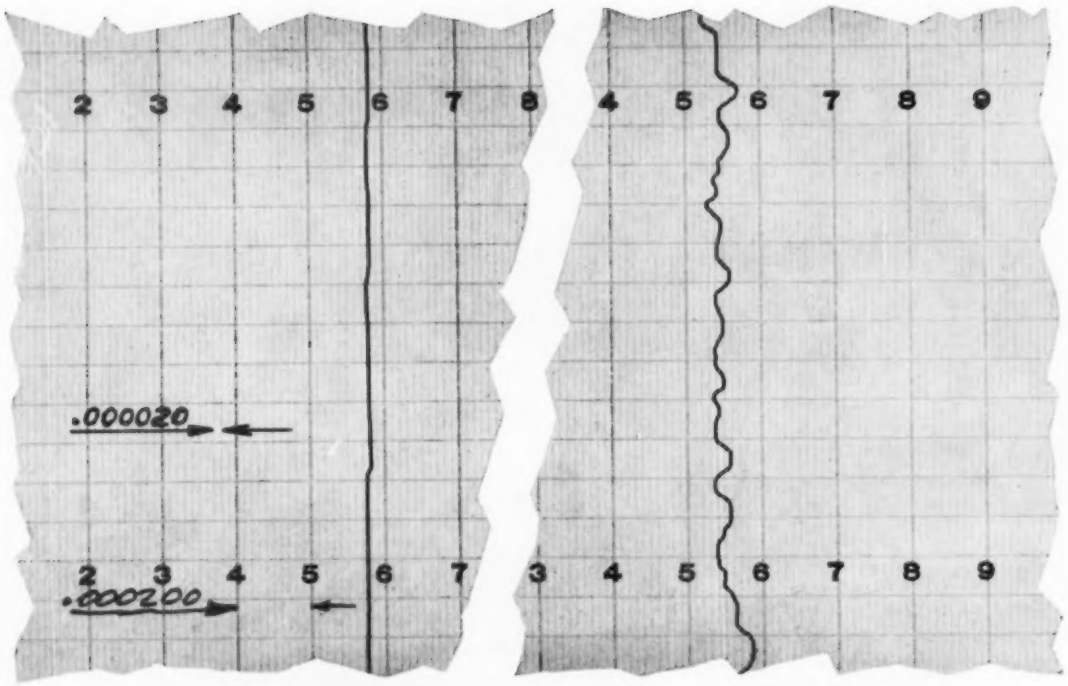



**Fig. 2 Template following errors (left-hand trace) measure about 0.000020 inch. Total workpiece error (right-hand trace) measures approximately 0.000140 inch.**

fine-resolution numerically controlled machine. The tracer-controlled machine operates in a room whose temperature is controlled to ±0.125 F. Hydraulic system temperature is held within ±1 F to avoid adverse thermal effects on accuracy and oil viscosity. Both positioning and adaptive servocontrols are used to minimize error and a monitoring recorder is used for error surveillance. For position control, the *X* and *Y* components of stylus deflection, as it moves over the template, are summed with speed information. Each axis then extracts its command from the resultant, properly controlling its respective slide. Mechanical deflection of the stylus supplies feedback to complete the servo loop. In operation, a tracing velocity command is supplied, causing the stylus to deflect. The servos then act to minimize this deflection as the stylus follows the template profile (and in parallel, the tool cuts the workpiece contour). Frequency response is approximately 15 cps from tracer to servovalves, indicating that only a short time lag is required to translate deflection into tool slide movement. The adaptive type controls govern two machining conditions, maintaining a constant speed and constant chip thickness. A potentiometer senses the tool distance from the workpiece centerline and varies rotational speed between 12 and 1000 rpm as required for constant speed. Tachometer feedback from the table drive motor is used to maintain constant chip thickness during machining.

Three different methods of metal removal can be used—single-point tools for turning and boring, a belt-driven grinding head using diamond wheels for abrasive metal removal and a Vonnegutt brush for light abrasive removal to fine finishes. As any one of the heads is used, the monitoring recorder plots error at the tracing head, thus giving a record of over-all performance of the system during the machining of a given workpiece. The trace obtained, as shown in *Fig.* 2, is essentially a record of the stylus excursions as it follows the template. After a workpiece is machined, a stylus is mounted in the cutting head in place of a tool and the workpiece contour is plotted on the recorder. This second trace (at right, *Fig.* 2) is a record of the accumulated inaccuracies.

Such permanent records of inaccuracies serve several functions in achieving accuracy. They make evident any long-range trends into servo or machine degradation. They assist in isolating the source of inaccuracy in any given workpiece. They provide data for analyzing the effect on accuracy produced by changing machining conditions. By this means, original machine accuracy can be conserved, and ultimately, with the accumulation of data and experience, the tool and cutting inaccuracies can be minimized. With servocontrols, adaptive controls and human analysis and control over metal removal inaccuracies, the error envelope can be made even thinner than it is now.

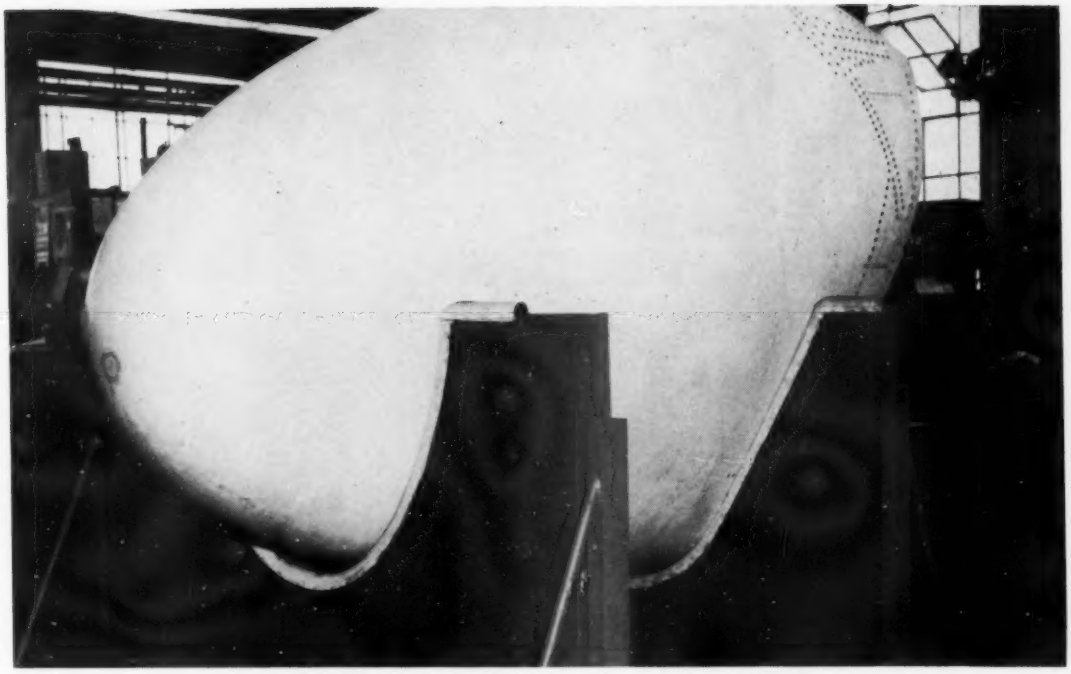


**Fig. 1. Radome for attack plane is filament-wound polyester, making drilling and countersinking operations difficult.**

# DRILLING laminated plastics without tearing

**By William Thomas and Sheldon Meyers**
Machinability Lab.
Equipment & Process Engineering Dept.
Grumman Aircraft Engineering Corp.
Bethpage, N. Y.

**Use of backup coatings of parting agent and epoxy prevents tearing of glass laminates when drills break through. Application developed for drilling of radomes obviates cumbersome backup materials and need for accurate fitting.**

DRILLING and countersinking materials that are too soft for conventional machining on a production basis may present many complicated problems. Those met in machining the radome, *Fig.* 1, of the new Grumman low-level attack plane, the Intruder, were no exceptions.

The radome is approximately four feet across the large end and is made of triallyl cyanurate polyester with bonded predrilled Dural on the inside or concave surface of the part. The part requires drilling, countersinking and routing, the latter two operations being performed on the convex side which has the polyester surface. Glass laminated polyester has a tendency to tear where the drill breaks through, *Fig.* 2. It also tears when countersinking.

Attempts to design an outside or concave drill template, using the inside attached part to back up the laminate, were unsuccessful. Possibly, this could be done if necessary, but it requires extremely accurate jigs to match the prepositioned blind holes in the Dural. Also, the cost would be excessive. The desirable method of manufacture should use the predrilled inside Dural material as a template for hole pickup. This involves drilling from the

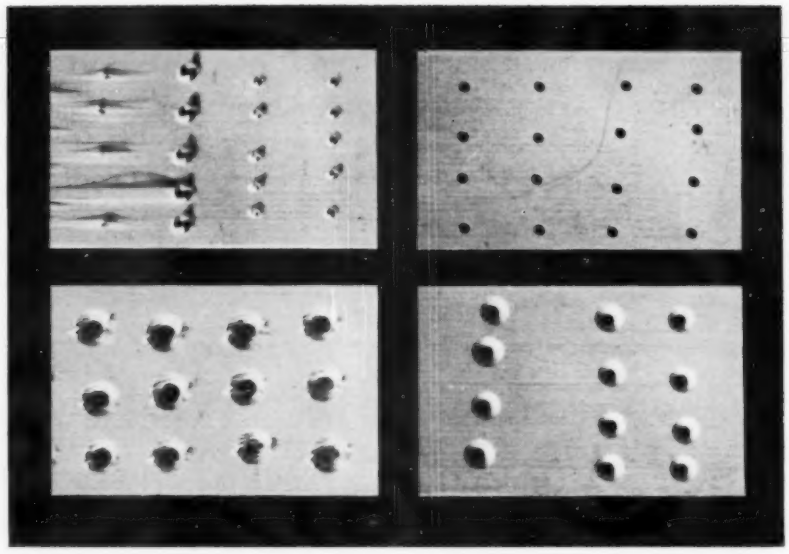
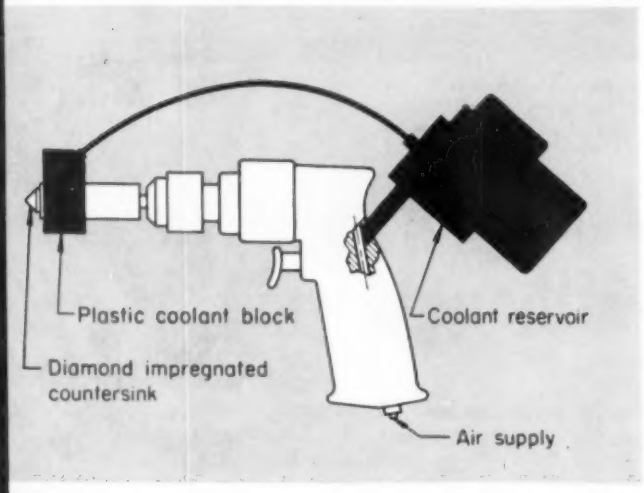


**Fig. 2. Test pieces of triallyl cyanurate polyester. Holes at left were drilled without backing. Those at right were drilled through epoxy backing. Countersunk holes at left were made with conventional tools and without backing. Those at right were bored with a diamond impregnated tool. The improvements in both cases are obvious.**

**Fig. 3. (below) Tool developed for countersinking glass laminates incorporates a coolant reservoir to flood the diamond countersink.**




inside. Although the finished hole is specified as No. 30, the initial drilling is done with a No. 40 drill. Hand-gun operation at a speed of 3600 rpm with type B drills is indicated.

Tests of different drills and point geometry failed to eliminate breaking the fibers on drill entry and breakthrough. Backup template material proved unsatisfactory and costly. Also, template material is technically unsatisfactory because the piece-part contour is difficult to back up. In addition to using the Dural as a template, drilling from the inside, the hole can be finish drilled to No. 30 size from the outside after countersinking operations. The countersink required for the job is a 100 degree with a $\frac{3}{8}$-inch diameter for flush flathead fasteners. The laminating strands in the polyester tear when machined with conventional countersinks, mutilating the tapered sides of the bore as shown in *Fig.* 2. Experiments showed, however, that a mounted grinding wheel, dressed to 100 degrees, makes a satisfactory countersink when used with a satisfactory coolant.

The problems of backup to minimize breakthrough damage were solved by the plastics section of the chemical engineeering group. This section developed a plastic material and parting agent that met all requirements. The new backing up process involves coating the outside of the radome with a paste wax parting agent. Then an epoxy backing is brushed over the prepared surface to a thickness about 0.10 inch. The problems of countersinking were solved by using a 100 degree diamond impregnated high-speed steel countersink. A spray unit, *Fig.* 3, was developed for use of coolant with the countersinking operation.

With the radome located in the fixture, the No. 40 holes are drilled from the inside, using the Dural member for location. Slot routing is then done from the outside through the epoxy backing. A Stanley hand router and a $\frac{1}{4}$-inch diameter solid carbide cutter is used for routing by hand feed. The epoxy resin backing is then removed and the countersinking operation is performed after which the holes are finish drilled to No. 30 size. The countersinking as well as the finish drilling operations are performed from the outside.

This radome job illustrates the approach used to solve production problems. It utilizes the experience of experts in the company's various departmental groups. Also, it is interesting to note that this job was completed within three weeks. Total time expended was less than 100 man-hours for the tests and development of the production methods for drilling, countersinking and slotting operations used in this application.

# electromagnetic metal forming

## —high energy exerts shaping force

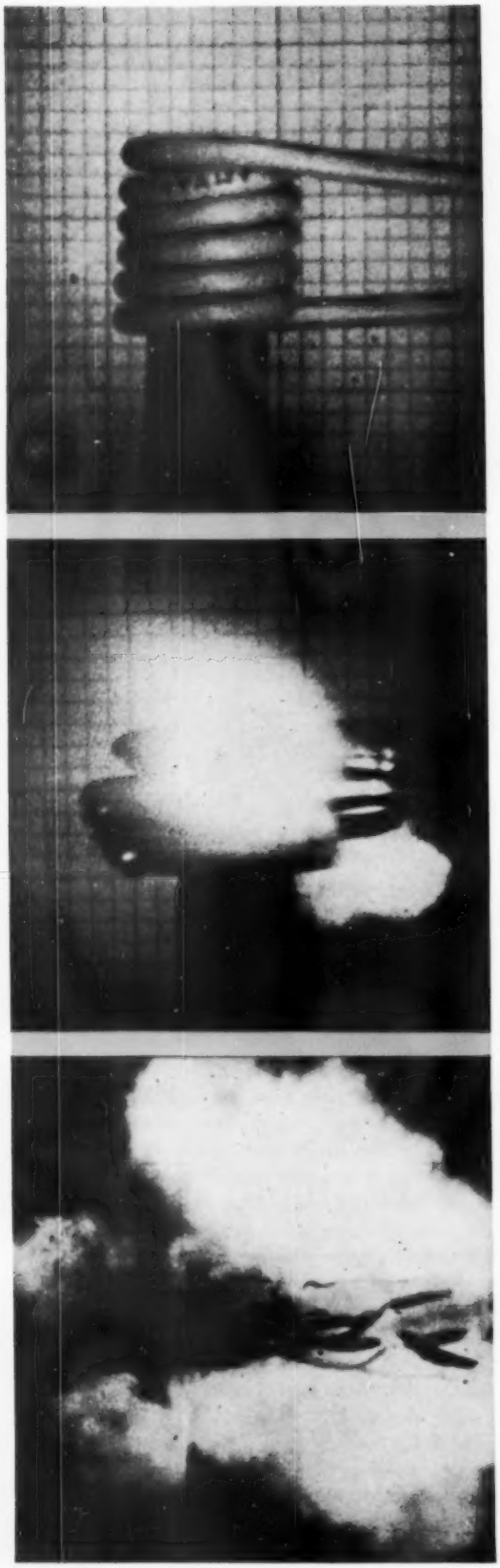
**By A. P. Langlois**
Supervisor
Applied Manufacturing Research
Convair Div.,
General Dynamics Corp.
San Diego, Calif.

**Unseen but powerful magnetic flux lines can exert enough pressure on conductive metals to exceed the metal's elastic limit and cause a permanent deformation. This is electromagnetic metal forming. The author describes how the forces are built up and applied to a workpiece.**

ELECTROMAGNETIC FORCE serves manufacturing engineers with versatility. Its range of usability extends from cranes lifting tons of scrap to solenoid operated devices and even to storing manufacturing data in the magnetic core memories of computers. This already considerable range has been extended by recent research into yet another useful application—the forming of metals by a sudden and powerful surge of electromagnetic force.

The power and speed of the metal-forming operation is shown in *Fig.* 1. A test part is shown being swaged with an expendable coil. The photos, made with a high-speed camera, show the swaging process in detail. The part is fully swaged in the second picture, taken about 80 microseconds after the first frame. Actual time required for swaging this part is less than 40 microseconds. The pictures following the second frame show breakdown of the expendable coil caused by the high levels of electromagnetic force. As it shatters, the coil is not producing any useful work.

To form workpieces using electromagnetic force, conductive metal parts are introduced in a coil in such a manner that they are flux-linked with the work coil and can be considered as short-circuited secondary single-turn coils. This means that the primary work coil current will be a maximum due to the short-circuited secondary. Consequently, when electrical energy is applied to the work coil, a net resultant magnetizing force is applied to the workpiece. When this energy exceeds the elastic limit of the workpiece material, permanent deformation takes place. Electromagnetic force applied to an aluminum tube, *Fig.* 2, shows this effect. To achieve this effect, energy must first be boosted to a high level and second, this energy must be applied to the workpiece in a specific fashion. These two main phases of electromagnetic metal forming are shown schematically in *Fig.* 3. The energy level is raised using a capacitor bank, and applied using either expendable or permanent coils.



**Pumping and Releasing Energy:** To form metal in a brief span of time, considerable energy is required at a high level. This energy state is obtained by "pumping" energy into a storage device and releasing it suddenly. Capacitors are fed with a charge to a suitable level and the charge is then suddenly released into the work coil. This is analogous to winding a clock spring tightly, to store energy, and then suddenly releasing it. Pumping time can be relatively long if necessary, but the release time should be limited to a short interval for the energy output to be at a high level. Capacitors are ideally suited for the sudden discharge of stored electrical energy.

The charging voltage (*E* in *Fig.* 3) is supplied by a high-voltage power supply, with voltage up to 30 kv. Limitations on the energy that can be stored are imposed by the breakdown point of the capacitor and by the output current capabilities of the power supply. For the amount of power needed to form metal, several individual capacitors are connected in parallel to form a capacitor bank. Energy stored in the capacitor bank varies directly with the value of the capacitance and as the square of the applied voltage. Thus, energy levels can be increased by adding capacitors to the bank or by increasing the charge voltage. Capital equipment costs limit the number of capacitors. The upper limit on voltage is imposed by the breakdown point of dielectric insulating materials on the work coils —about 10 kv.

A high voltage switching circuit is used to discharge the stored energy. Ignitron tubes, in series with each capacitor, switch the charge into the work coil. A separate high vacuum, high voltage switch

**Fig. 1. Electromagnetic force used to swage a workpiece bursts an expendable coil.**

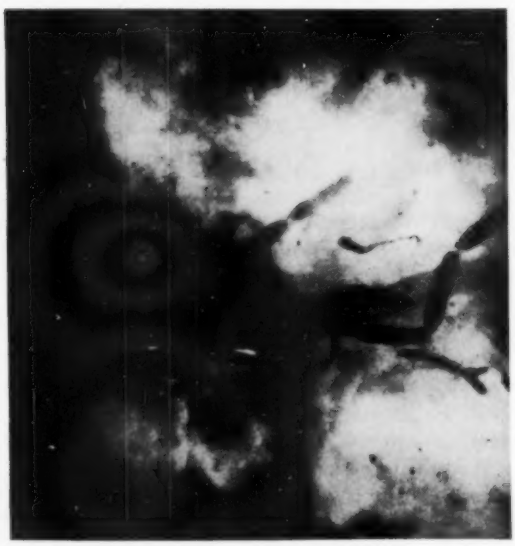


**Fig. 2. Aluminum tube is permanently deformed by the application of a surge of electromagnetic force.**

is used to trigger the ignitrons. Upon discharge of the capacitor bank, the output current follows one of three possible wave forms. With resistance-limited, overdamped pulses, the peak currents are suppressed and averaged out over a long time period. This is undesirable for a short, intense forming cycle.

A second form of pulse is oscillatory and is the most common form. It is acceptable except for parts where metal thickness or configuration requires all available power. For these parts, oscillation suppression circuits are needed, so that only the first peak is employed for metal forming. This is the third pulse form, where rise and decay of

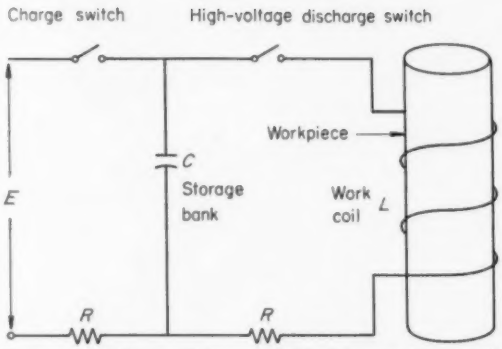



**Fig. 3. A voltage, *E* is stored in the capacitor bank *C* and applied to the workpiece by coil *L*.**

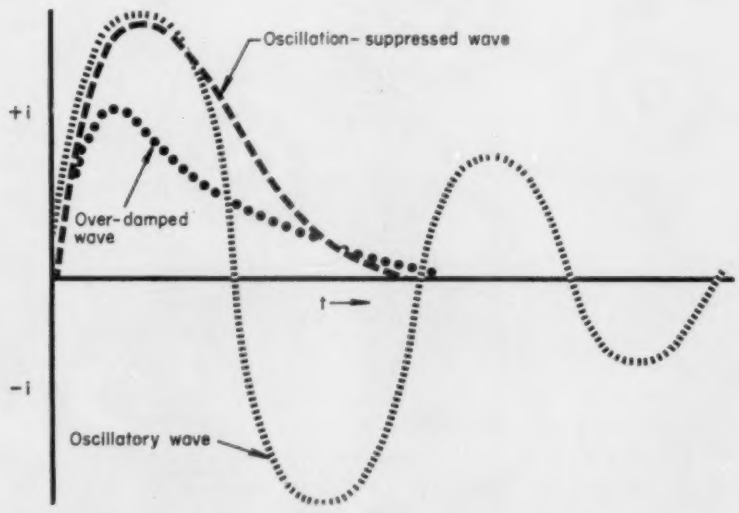



**Fig. 4. Three different waveforms can be supplied by the capacitor bank into the work coil.**

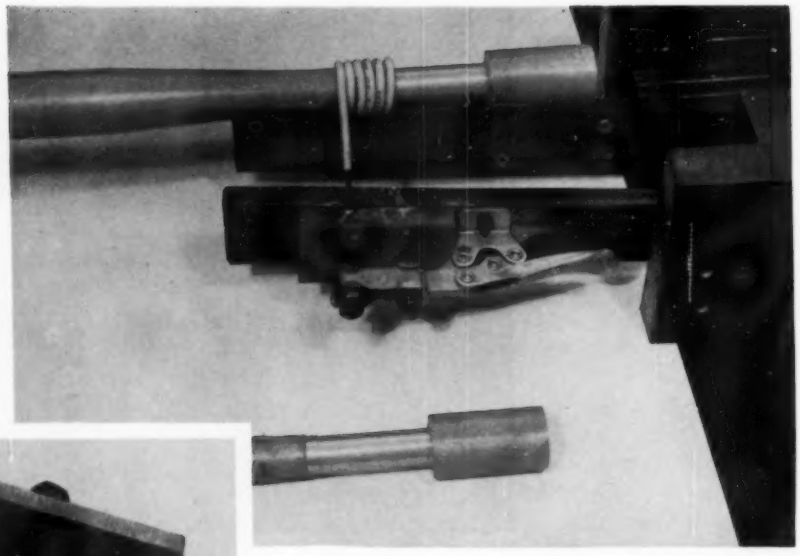
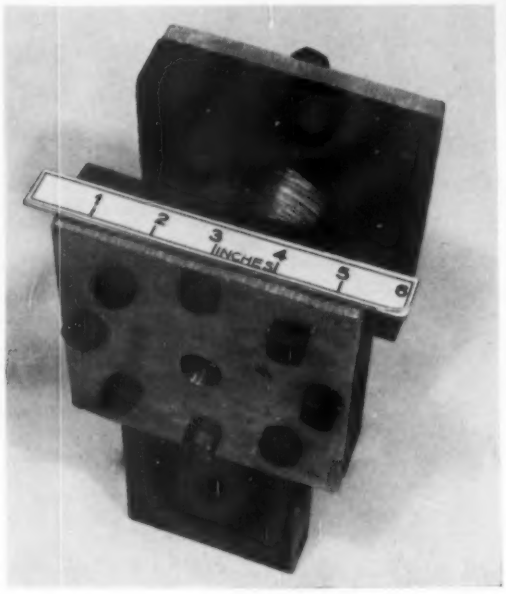


Fig. 6. (right) Plastic coated wire costing a few cents serves as an expendable work coil.

Fig. 5. (below) Machined square-section is wrapped in preimpregnated glass roving and bolted between end plates to form a permanent coil.




current take place in the minimum possible time. These three wave shapes or discharge pulses are shown in idealized form in *Fig.* 4.

**Work Coil:** In applying electromagnetics to metal forming, adequate work coils must be provided to transform the energy stored in the capacitor banks. Coil design effort has taken two paths—permanent coils and expendable coils. Early permanent coil design efforts used solid copper rod stock to swage aluminum tubing onto various pieces of hardware used as mandrels. In later permanent coil designs, a machined helix with rectangular cross section is used. This is insulated with preimpregnated glass roving wound under tension until all spaces between turns are filled. As shown in *Fig. 5*, roving is also wound around the coil to reinforce against radial expansion. End plates of 1-inch Micarta and 0.375-inch aluminum alloy are bolted together to complete the coil.

Expendable coils have been developed, composed of a few turns of plastic insulated copper wire, as shown in *Fig. 6*. The coils are wound on mandrels having the same OD as the part and then slipped over the part end. Shields must be used to protect against flying copper debris when the expendable coils are used. The expendable coils cost a few cents and permanent coils hundreds of dollars.

**Applications:** Various control rods and torque tubes have been swaged and the process variables established. A terminal end sleeve was attached to a cotton escape rope and connector strength exceeded that of the rope. Several other detail parts have been swaged also. Investigation has been made in the area of blanking, forming, embossing and drawing metals. The same basic approach is used and power sources are identical, but the work coil has been different. Flat spiral coils have been used and results are fairly well fixed for aluminum and aluminum alloys.

Electromagnetic forming is presently limited to small parts, usually 12 inches in diameter or less for a blank size for forming and up to 0.125 inch in thickness of the conductive material. Capability depends on energy storage and the ability to utilize that energy efficiently to do useful work. Further investigation of energy storage and release, and of coils will improve the process. But at present, the process is controllable and provides a method of performing tasks at a quality level difficult to exceed by other means and sometimes impossible by other means.

From a paper presented at the ASTME Seminar "High Energy Rate Forming." Single copies of the complete paper which contains a full description of the process are available without charge from Society Headquarters.

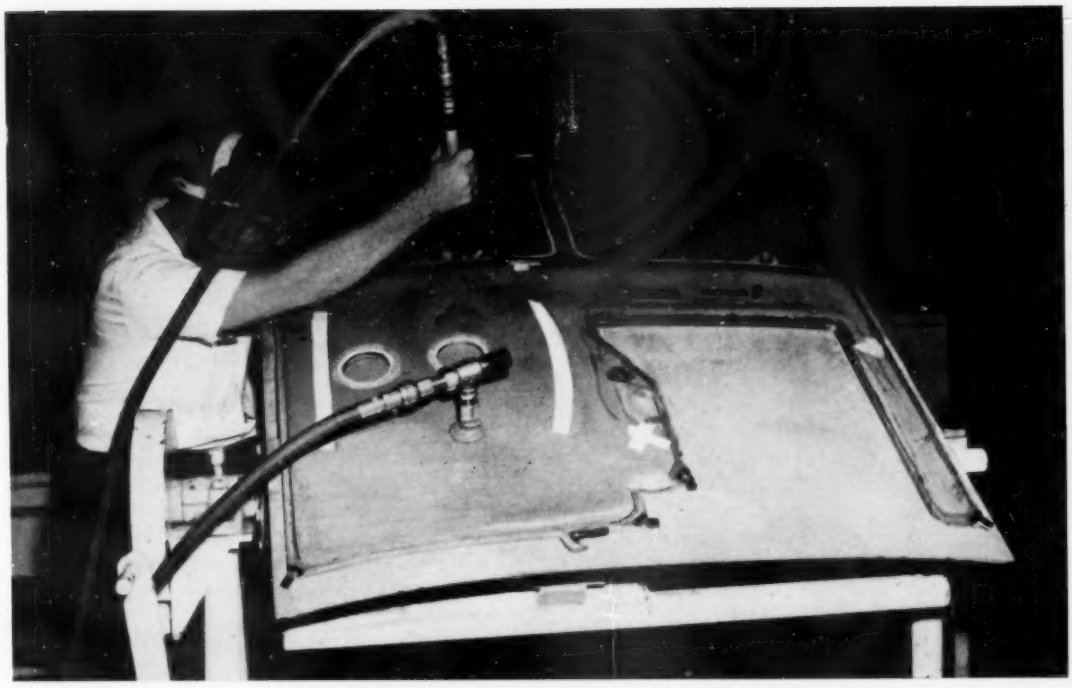


**Fig. 1. Clamped securely between two bonnets by vacuum, a thin aircraft skin is profiled using a hand router.**

# CLAMPING THIN SKINS —vacuum outholds pressure

**By F. M. Partridge**

**Manufacturing Research Engineer**
**Chance Vought Aircraft, Inc.**
**Dallas, Texas**

**Ingenuity, epoxy laminate and a venturi for vacuum add up to an inexpensive and highly satisfactory means for holding thin and flexible workpieces having irregular surfaces. Results — better finish and accuracy in contouring these hard-to-hold aircraft skins.**

HOLDING THIN, flexible and irregularly surfaced workpieces is one of the more difficult clamping jobs encountered by tool and manufacturing engineers. Typical of the difficult-to-hold parts is a chemically milled aircraft skin, *Fig.* 1. Quality of the hand profiling operation shown depends to a considerable degree on the quality of holding. Heavy clamping can stress the workpiece. If the workpiece is lightly clamped, it tends to flex and vibrate under the tool-imposed cutting loads. As it vibrates, finish deteriorates and as it flexes, accuracy decreases.

Production difficulties encountered with mechanical and hydraulic clamping led to development of a vacuum clamping method. When mechanical or hydraulic clamps are used, the clamping pressures are usually applied at intervals along the workpiece. During the profiling operation, there is a tendency for the portions of the workpiece not in

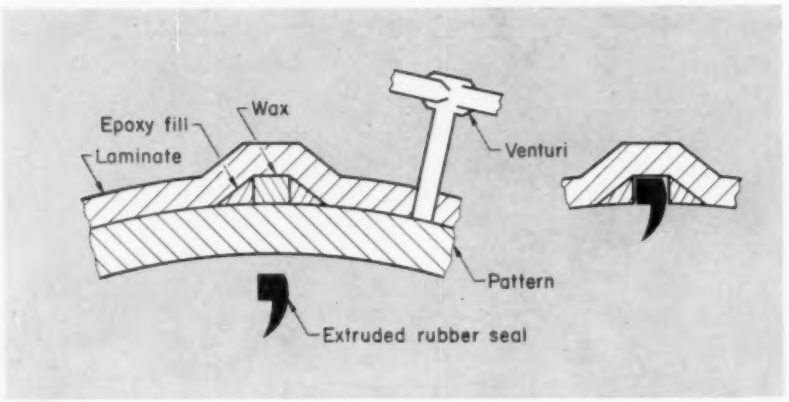



**Fig. 3. Cast grooves, an extruded rubber seal and a simple venturi vacuum source are used in the final and improved vacuum clamp.**

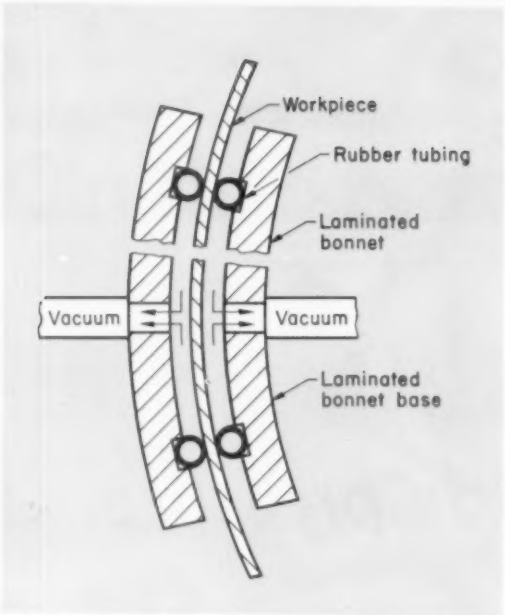



**Fig. 2. Rubber tubes were inserted into grooves routed in the laminate to make the seal on the first operationally successful vacuum clamp design.**

direct contact with the clamps to vibrate. Furthermore, it is especially difficult to provide adequate mechanical clamping of compound contoured workpieces any time that a slight mismatch exists between the workpiece and its support bonnets. The mismatch lets the part shift when clamps are removed locally to permit profiling. Several methods of clamping were carefully investigated and rejected by engineers at Chance Vought before the method shown in *Fig.* 1 was finally adopted.

Bonnet holders were first produced of epoxy laminate built up to around 0.375-inch thickness. A groove for vacuum sealing was then routed around the periphery of each laminated bonnet and a rubber tube was fitted into the groove as shown in *Fig.* 2. The tubing protruded sufficiently to compensate for bonnet-to-workpiece mismatches as great as 0.125 inch. When tested under shop conditions, the clamp held the skin securely, but was considered unsatisfactory for two reasons. First, it was difficult to effect the seal and second, undesirable bonnet flexing occurred outboard of the seal because the laminate was only 0.06-inch thick in the grooved section.

Further study revealed an improved method of fabricating the bonnet. The groove was produced by laminating over wax, as shown in *Fig.* 3, so that the integral groove is ready to receive the seal as soon as the wax is removed. An extruded rubber seal was found to adapt more readily than rubber tubing to the uneven workpiece surface. Vacuum for holding the chemically milled skin between the two bonnets is obtained using a shop air supply hose and a simple venturi device.

Some maintenance is required to keep the rubber seals in a satisfactory sealing condition. Vacuum clamping is not recommended as a replacement when mechanical sealing is adequate. But for difficult-to-hold workpieces, the vacuum clamping technique speeds up production and improves workpiece quality at a relatively low cost.

*"Who recommended a machine with the gall to tell me I'm wrong!!?"*

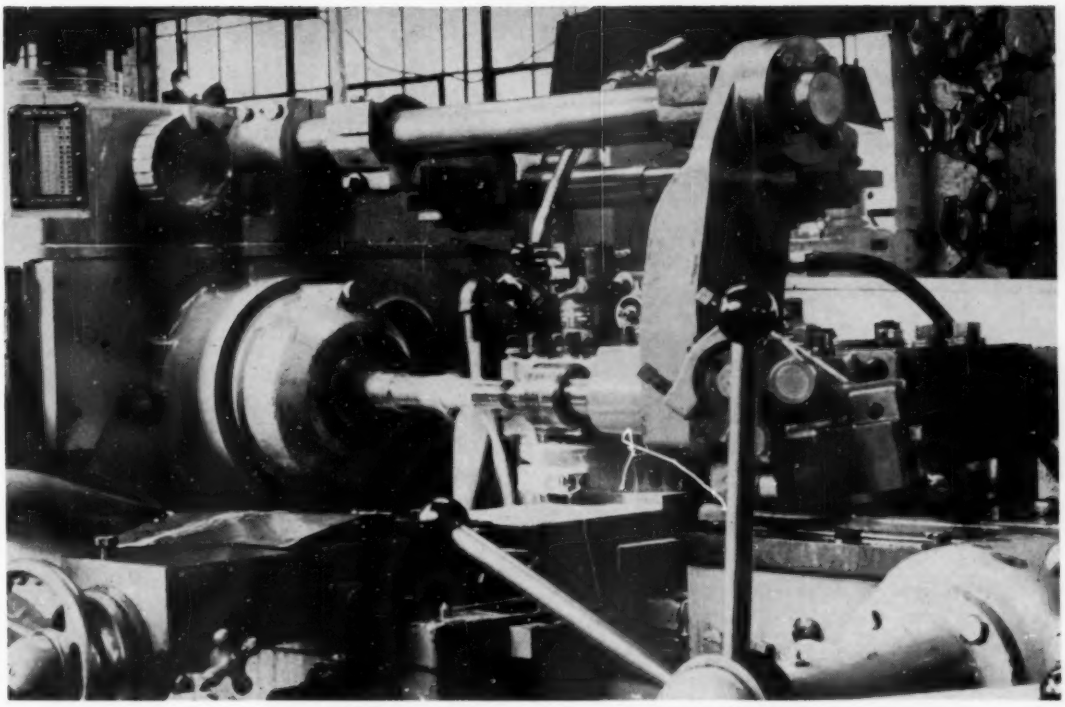


**Fig. 1. Rigidly held in a tandem collect and tailstock, a motor shaft is turned to tight concentricity specifications.**

# machining shafts straight —by overcoming warpage

**By Joseph C. Bott**

Tool Engineer
The Warner & Swasey Co.
Cleveland, Ohio

**Because they rotate at high speeds, motor shafts must be produced with a minimum of imbalance and eccentricity even though machining may cause shaft warpage. To eliminate distortion, the author developed an unusual holding method employing a tandem collet.**

STRESSES built into stock by prior operations can be the source of shaft eccentricities that exceed functionally allowable amounts for rotating members. The stresses exist in the stock—whether hot rolled or cold rolled—before machining begins. When the bar is chucked in a lathe and turned, metal is removed and the stresses or bottled forces, being to some degree released from the constraint of surrounding metal, exert themselves in ways not possible before metal removal. Warpage results. Thus, a turned workpiece, concentric while in the lathe, warps upon removal so that end-to-end eccentricity results. As the metal warps, the physical centerline departs from a true centerline by as much as 0.005 to 0.010 inch in a 24-inch shaft.

**Avoiding Eccentricity:** Various methods can be used to avoid this end-to-end displacement of the physical centerline from a true centerline. One

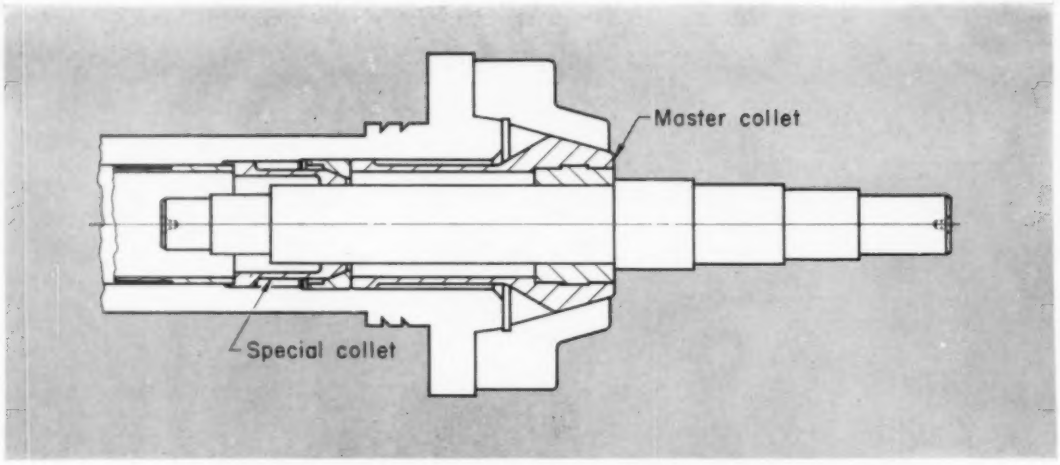



**Fig. 2. Tandem collet arrangement grips the shaft in two places, providing rigid support and accurate alignment of the shaft during machining.**

method is to apply a stress-relieving process to the stock prior to machining. This method does, however, require additional equipment, delay, handling and costs. For these reasons, engineers at Baldor Electric Co., employed a different method for turning motor shafts. An engine lathe was supplemented by a cutoff saw, a centering machine and a grinder. Shaft warpage was countered by machining the shafts oversize and then grinding the workpieces to required limits. Though successful, the method had some drawbacks. More handling was required than Baldor's engineers felt was desirable. Unbalanced armatures sometimes showed up during final motor assembly, requiring disassembly and remachining of the shaft, which is costly. Feeling that better results were obtainable, the method shown in *Fig.* 1 was developed.

The new machining method is a distinct departure from earlier methods. Misalignment caused by warpage is removed at the machine, a Warner & Swasey turret lathe. This eliminates much of the handling time and expense inherent in the original shaft machining setup. Starting with a fresh analysis of ways to compensate for the inevitable warpage, new methods of work holding were brought to bear. The tandem collet, *Fig.* 2, is arranged to lessen workpiece deflection during machining and to allow repositioning the workpiece between rough and finish cuts, to cope with warpage.

**Operation:** After slugging the shafts on a cutoff saw, the workpiece is located longitudinally by a stop in the spindle and gripped in the tandem collet. By this arrangement, one-half of the shaft is firmly held within the spindle, the other half projects for machining. Essentially, this amounts to reducing beam deflection by reducing the unsupported beam span by one half. Rigidity gained by this holding arrangement enables heavier feeds than had previously been possible.

The shaft is machined one half at a time—while one end serves for holding, the other end is machined. The shaft is then switched end-for-end and the other half machined. During the machining of either half, a recentering operation is made between rough and finish cuts. The recentering is used to re-establish alignment after the roughing cuts, to compensate for shaft warpage. The finish cut is light but sufficient to remove the warped portions of the shaft. This amount of metal removal is so slight that little or no additional warpage occurs.

In detail, the first cut is drilling the center used for support during the two ensuing rough cuts. After roughing, an end facing cut completely removes the original center and the shaft is recentered for finish machining. The rough cuts are made at 450 fpm with 0.018 ipr feed; finish cuts at 650 fpm using 0.007 ipr feed using two different negative-rake carbide insert tools. After this sequence of cuts is completed, the shaft is turned end-for-end, and held on the finished surfaces in the tandem collet, exposing the remaining half of the shaft. The same machining sequence is repeated.

Production of shafts has improved significantly —they are machined to greater accuracy with less handling, fewer operations and higher cutting speeds than in the original operation. End-to-end concentricity is held to a 0.0015-inch TIR on a 28-inch shaft. Stock left for removal by grinding is now held to 0.008 inch instead of the 0.020 inch previously required. Rework of unbalanced armature assemblies has also been sharply reduced. The warpage has not been eliminated, but its effects have been overcome economically by a careful analysis of the forces involved and the use of tooling and machining that take account of these forces.

# establishing DIMENSIONS and TOLERANCES for gaging

**By P. L. Stewart**
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**New method for specifying gage locator tolerances avoids interference fits for acceptable parts and provides for maximum tolerances during part production.**

COMMON METHODS for establishing dimensions and tolerances of gage locators result in consuming some of the workpiece tolerance. The gage locator is dimensioned to correspond to the maximum material condition of the product part. Also, the direction of the gage locator tolerance is the same as that of the work. Since this gage tolerance is usually 10 percent of the part tolerance, the gage will not fit when a part is at maximum material condition. Therefore, the manufacturer has to allow a slip fit sufficient for fitting on the part. This slip fit, plus the gage locator tolerance, reduces part tolerance left to the manufacturer.

Now, a method for establishing gage locator dimensions and tolerances eliminates this situation, allowing the manufacturer to see the full tolerance specified on the product part drawing. The new method, based on the dimension of the part datum at maximum material condition, includes the slip fit allowance as the basic dimension of the locator.

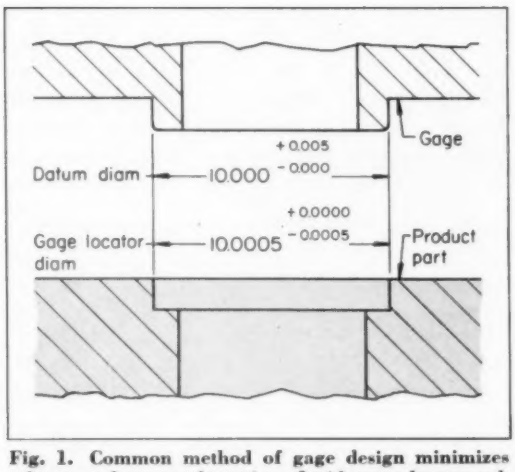



**Fig. 1. Common method of gage design minimizes tolerances for manufacturing. Inside gage locator tolerances have interference fit.**

**Commonly Used Method:** In the commonly used method, *Fig.* 1, there is an interference fit of 0.0005 inch when both the gage locator and the part are in a state of maximum material condition, i.e., when the gage locator diameter is its largest and the product part datum diameter is the smallest. *Fig.* 2 also illustrates an interference fit when the gage locator and part are at maximum material condition, i.e., when the gage diameter is at its smallest and the part is at its largest. This interference fit also equals 0.0005 inch.

The resultant relationship between the gage locator and the product part definitely affects the

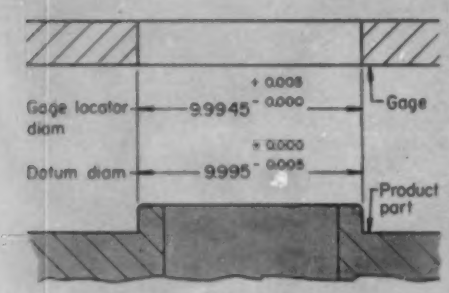



**Fig. 2. Outside gage locator produces interference fit for acceptable parts.**

**Gage Locator Clearance Allowance Limits**

| Nominal Size Range (inch $10^{-3}$) | Limits of Clearance Minimum (Class RC 1)* | Limits of Clearance Maximum (Class LC 1)† |
|---|---|---|
| 0.04 - 0.12 | 0.1 | 0.45 |
| 0.12 - 0.24 | 0.15 | 0.5 |
| 0.24 - 0.40 | 0.2 | 0.65 |
| 0.40 - 0.71 | 0.25 | 0.7 |
| 0.71 - 1.19 | 0.3 | 0.9 |
| 1.19 - 1.97 | 0.4 | 1.0 |
| 1.97 - 3.15 | 0.4 | 1.2 |
| 3.15 - 4.73 | 0.5 | 1.5 |
| 4.73 - 7.09 | 0.6 | 1.7 |
| 7.09 - 9.85 | 0.6 | 2.0 |
| 9.85 - 12.41 | 0.8 | 2.1 |
| 12.41 - 15.75 | 1.0 | 2.4 |
| 15.75 - 19.69 | 1.2 | 2.6 |

*From Tool Engineers Handbook Edition 2, Table 86-7.
†From Tool Engineers Handbook Edition 2, Table 86-8.

tolerance which the manufacturer uses to machine the part datum diameter, since this diameter must be held to a size which will allow the part to fit on the gage, and at the same time keep within tolerance limits.

For a gage locator within a range of 10.000 inches in diameter, the minimum slip fit would be 0.0008 inch[1]. Therefore, in both *Figs.* 1 and 2, the interference fit of 0.0005 plus the minimum slip fit allowance of 0.0008 equals the sum total of 0.0013-inch tolerance lost to the manufacturer in machining the part datum diameter.

If the product part datum diameter has a tolerance of 0.005 inch, the loss of tolerance will amount to 26 percent. This loss is far above the desired 10 percent usually set as the maximum tolerance the gage may steal from the part. Naturally, this percentage of tolerance loss varies with the amount of the product part tolerance and is greatest when the part tolerance is smallest.

**New Method:** The new method of establishing dimensions and tolerances for gage locators is derived from the *American Standard*[2] and from the *Tool Engineers Handbook*[3].

A comparison of the various classes of fits and the related descriptions of these fits and limits has revealed that the combination of two classes of fits would result in a more efficient method of dimensioning and assigning tolerances for gage locators. The two classes selected are:

> Close Sliding Fit[4], Class RC 1: These fits are intended for the accurate location of parts which must assemble without perceptible play. This class has a minimum as well as a maximum clearance limit.
>
> Clearance Location Fit[5], Class LC 1: This class is intended to determine only the location of the mating parts, providing a rigid or accurate location, and has a minimum clearance limit of zero.

[1]References are listed at the end of article.

Both classes of fits can be used for accurate location; however, the minimum clearance of zero for Class LC 1 could occur where parts are in metal-to-metal contact with the gage locator and would result in the part fitting too tightly on the gage locator. Since the LC 1 Class fit has a maximum limit that is less than that of the Class RC 1 sliding fit, combining the two classes would result in a minimum clearance as well as a closer maximum limit. This is the basis for the accompanying table for assigning tolerances for gage locators.

As previously noted, the new method of dimensioning is based on the dimension of the product part datum at maximum material condition and includes the minimum clearance allowance as the basic gage locator dimension. The tolerance of the gage locator is the difference between the limits of clearance minimum for the RC 1 Class and the limits of clearance maximum for the LC 1 Class.

Illustrations, *Figs.* 3 and 4, show the relationship between the gage locators and the same parts used in *Figs.* 1 and 2 when the new method of dimensioning and assigning tolerances is used. *Fig.* 3 shows the inside locator being used on the same part as in *Fig.* 1. The total allowable clearance between the gage locator and the part datum diameter, which is at maximum material condition, will not exceed the maximum limit of clearance as defined by the Class LC 1 fit. This is shown by:

| | |
|---|---|
| Min Datum Diam (MMC) | 10.0000 |
| Min Limit of Clearance (RC-1) | 0.0008 |
| Gage Locator Diam | 9.9992 |
| Max Limit of Clearance (LC-1) | 0.0021 |
| Min Limit of Clearance (RC-1) | 0.0008 |
| Tolerance of Gage Locator Diam | 0.0013 |
| Min Part Diam | 10.0000 |
| Min Gage Locator Diam | 9.9979 |
| Max Limit of Clearance (LC-1) | 0.0021 |

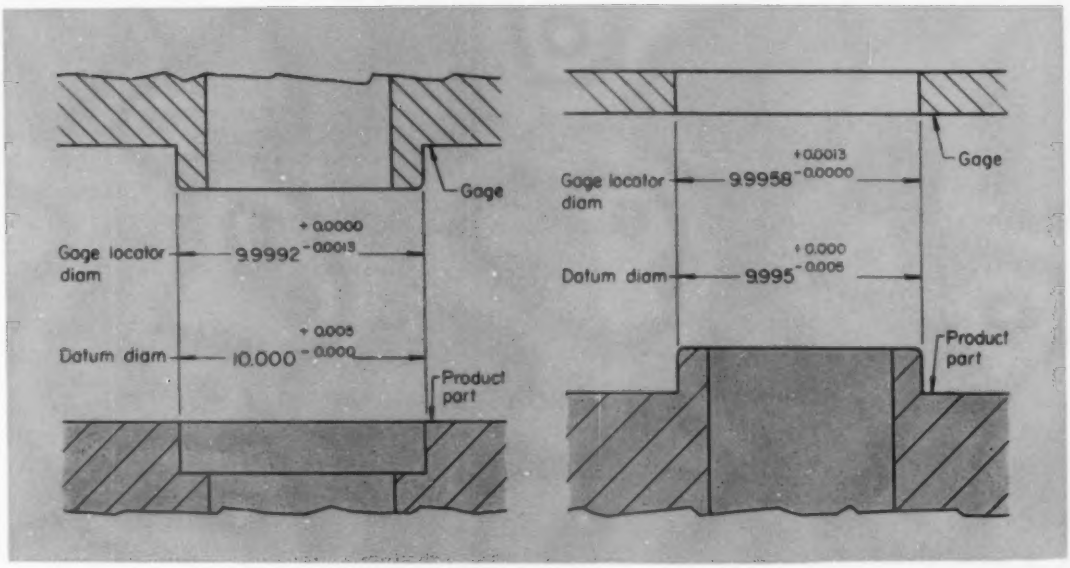



**Fig. 3. (Upper left) New method of specifying tolerances for inside locators obviates interference fits and gives part manufacturer wider tolerances.**

**Fig. 4. (Upper right) Outside locator design shows clearance for extreme conditions with new method.**

Also, similar calculations for *Fig.* 4 show that the extreme conditions of tolreances of gage and part will not produce an interference fit. These calculations for the gage illustrated are

| | |
|---|---|
| Max Datum Diam (MMC) | 9.9950 |
| Min Limit of Clearance (RC-1) | 0.0008 |
| Gage Locator Diam | 9.9958 |
| Max Limit of Clearance (LC-1) | 0.0021 |
| Min Limit of Clearance (RC-1) | 0.0008 |
| Tolerance of Gage Location Diam | 0.0013 |
| Max Gage Locator Diam | 9.9971 |
| Max Datum Diam | 9.9950 |
| Max Limit of Clearance (LC-1) | 0.0021 |

The new method of dimensioning and establishing tolerances has three distinct advantages. The gage will fit the product part when the datum diameter is at maximum material condition. The manufacturer can see the full product part datum tolerance when machining the datum diameter. The new method allows a larger tolerance for the gage locators than that allowed with the common method.

**References**

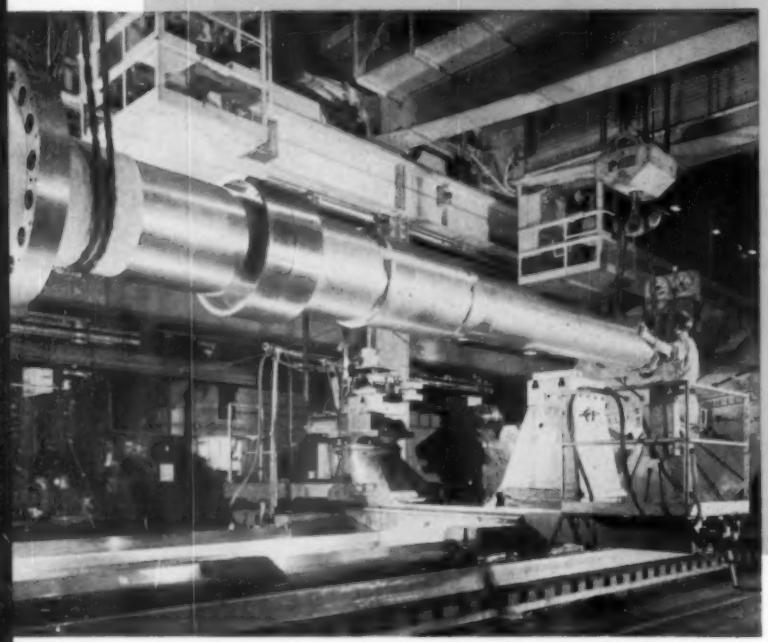

1. A.S.A. B41-1955, *Preferred Limits and Fits for Cylindrical Parts*, American Standards Assn., New York.
2. Ibid.
3. *Tool Engineers Handbook Edition 2*, ASTME, Detroit, Mich. McGraw-Hill Book Co., Inc., New York, 1959.
4. Ibid, Table 86-6.
5. Ibid, Table 86-7.


## Engineer Designs Surgical Tool

Surgical instrument, developed by General Motors Research Laboratories engineers, adds to the long list of accomplishments wherein engineering talent has aided the skilled hands of a surgeon. The instrument, a remotely controlled catheter, can be directed through the pulmonary artery into the human's heart cavities and passageways for diagnostic purposes.

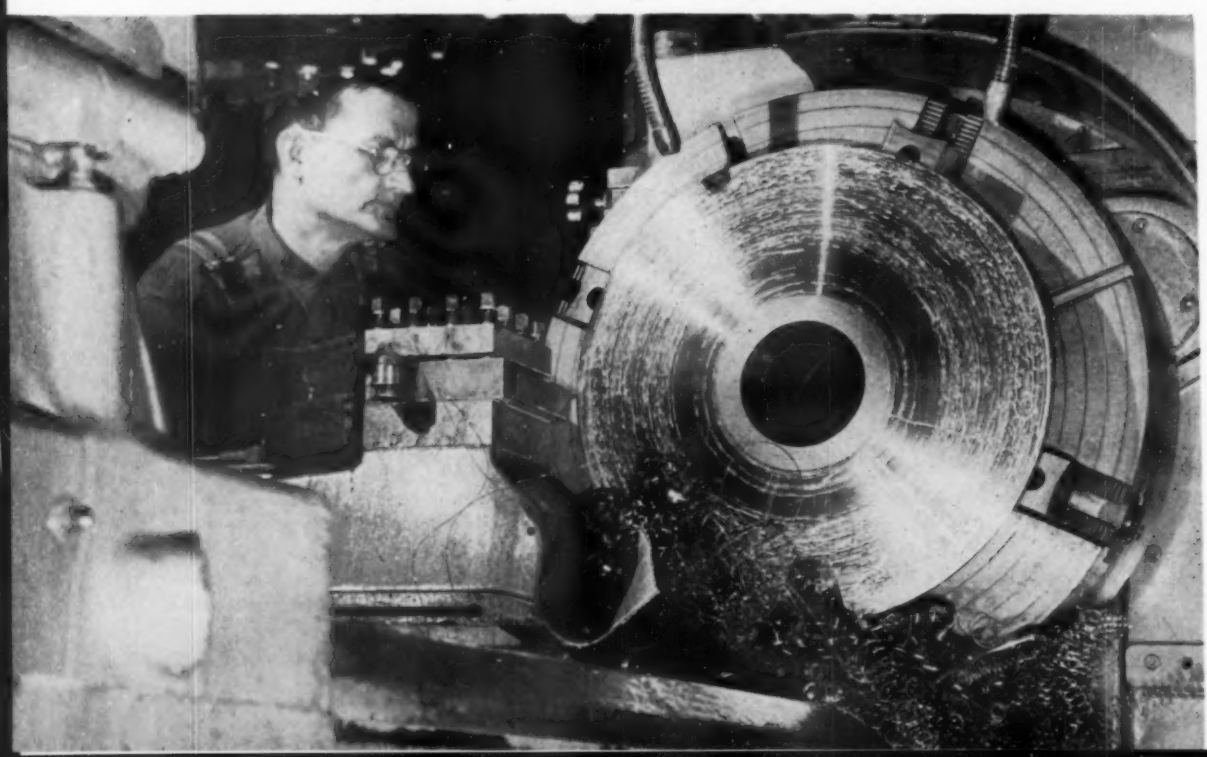
Charles W. Gadd headed the design project for General Motors and worked with Richard J. Bing, M. D., professor of medicine and chairman of Wayne State University. The catheter already has been used on humans and Dr. Bing has indicated it may become an important instrument for studying heart disease. Although precision built, indications are it can be manufactured at reasonable cost.

Catheters are flexible small diameter tubes commonly used for measuring blood pressures, obtaining blood samples or making other observations within the human heart. With remote control, the technique of inserting the catheter and obtaining data from inside the heart may be speeded considerably.



TWO CRANES work together to remove a 97,000-lb. shaft from a large Betts-Bridgeford geared-head lathe on which it was machined. Carbide tooling with indexable inserts was used for semi-finishing at 150 to 200 fpm, with feeds of 0.031 to 0.042 ipr and a depth of cut up to 0.375 inch. Finish turning was done, using high-speed steel tools, at 30 to 50 fpm at a feed of 0.55 ipr. Final finish to 16 microinches in critical areas was produced by abrasive polishing and tolerances were held to +0.000 inch, —0.001 inch in critical areas. Some 11,000 lb of chips were removed in these passes at the West Allis plant of Allis-Chalmers Mfg. Co.

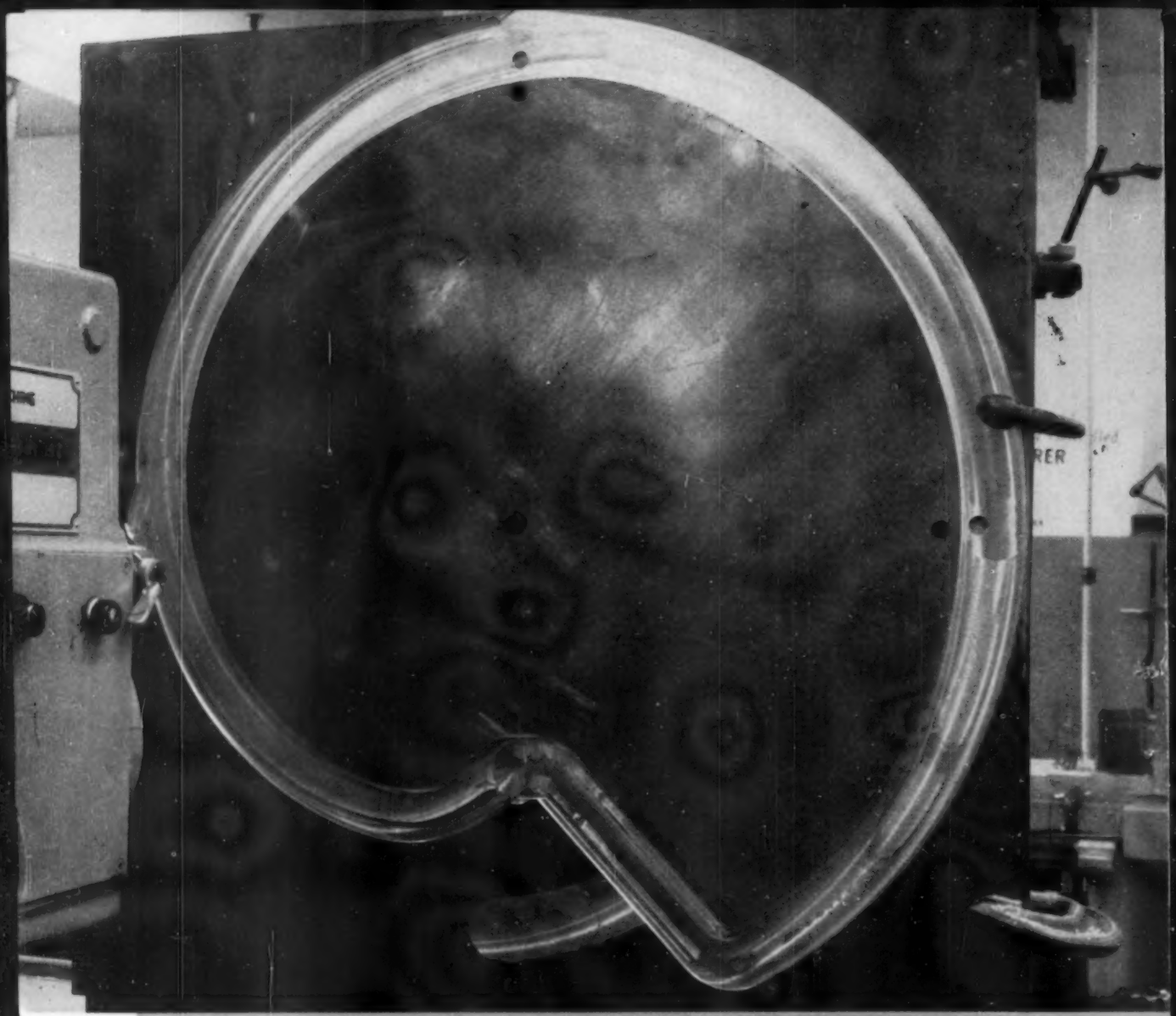
GEAR RIM is machined from a heavy alloy steel forging at the forge shop of Cann & Saul Co. For machining open die forgings of medium carbon steels, stainless, titanium and alloys, multiple carbide tooling is generally used. This, coupled with the use of turret lathes, provides the quick handling and setup versatility needed for small-lot (one to four pieces) production. Heavy metal removal rates are preferred and, in some instances, the Warner & Swasey turret lathes remove 80 lbs of metal in three minutes. Cuts up to 1 inch deep at 300 fpm and 0.025-inch feed are not unusual.



# TOOLS at work

**Numerically controlled milling machines are versatile to a point that it is sometimes difficult for manufacturing engineers to determine what type of part should be produced on these machines. Several different criteria apply, as evidenced by the workpieces shown on the following three pages—large parts, small parts, complex parts and simple parts were all produced advantageously using a Bendix controlled Numeric-Keller in the shops of the Pratt & Whitney Co.**

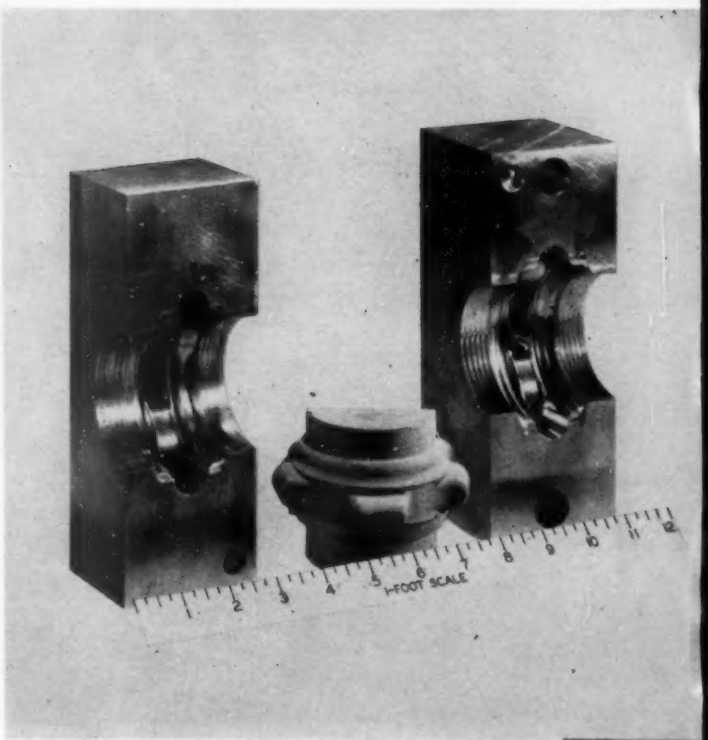
OIL GROOVE PATTERNS in the base of a rotary table are machined in 40 minutes, floor-to-floor time, in an operation at Pratt & Whitney. Because the cutter center follows the oil groove centerline, and only straight lines are involved, tape programming is simple and direct. Production on a manually controlled machine tool 4.5 hours and, due to the many swinging and shifting operations, scrap pieces were sometimes produced. To date, the tape-controlled machine has produced no scrap.

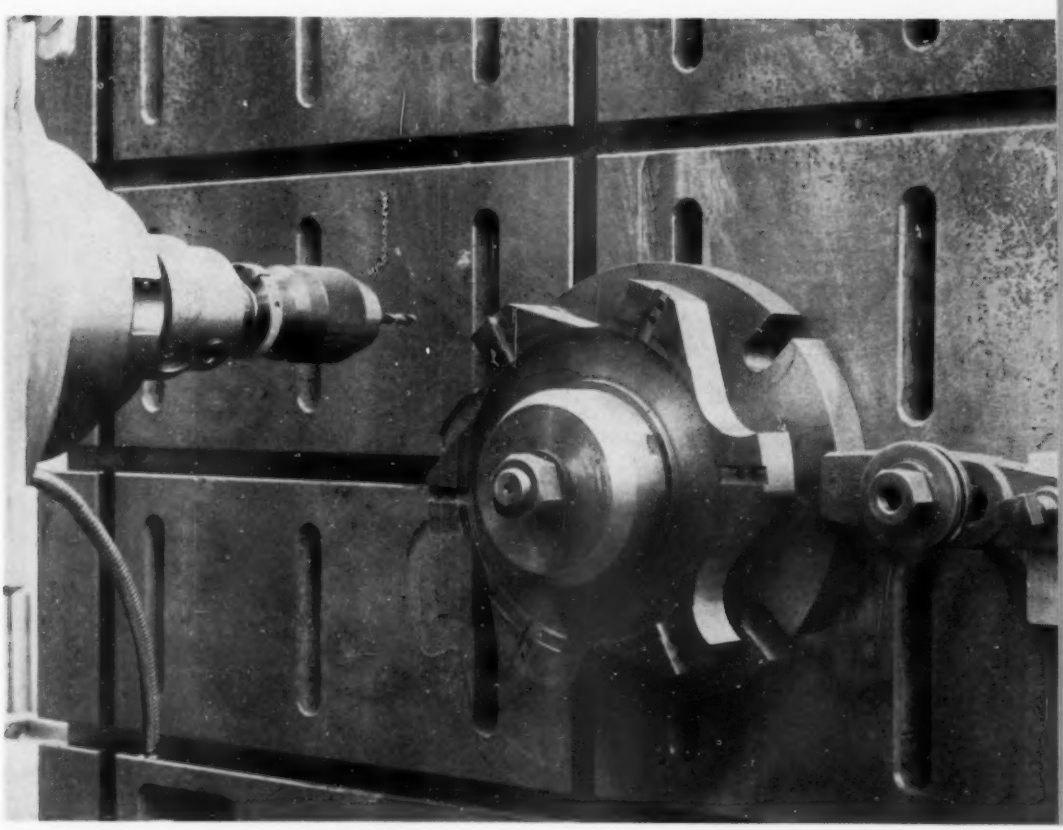


LARGE MASTER CAM, scaled up twenty times, exceeds the capacity of machine that produced it. The cam periphery was machined 90 deg at a time. After each quarter was machined, the cam was rotated 90 deg and the operator trammed in to cut the next quarter. Blends between adjoining 90-deg cutter paths measured less than 0.001 inch. Tape-making time was two hours and machining the cam periphery in three passes took two hours.

# TOOLS at work

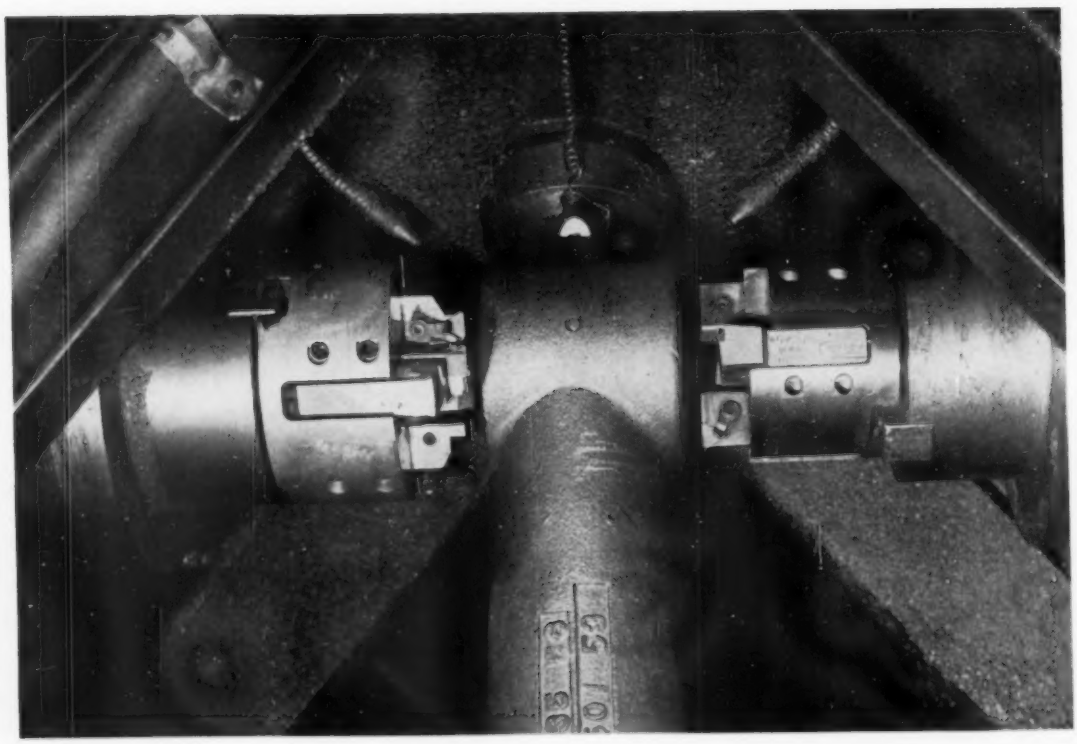
FOR TOOLING UP other machines, numerical control is helpful because of low fixturing costs, short lead time and high repeatability, which led to its use in producing these two workpieces. To produce a canning machine cam (below) several operations were completed in one setup. The cam path and slots were milled and the holes drilled and tapped without intermediate material handling or removal from the machine. Computation was held to a minimum by computing the path for one lobe only and then repeating the path for successive lobes. For the automotive rod cap forging die (right), processing and computing required 280 hours due to the complex form, and was completed in two weeks. Machining was completed in 4 hours and roughly another hour was required for bench work and polishing. For high production work, requiring a large number of identical dies, economies result along with improvement in finish and accuracy. Also, the tapes can be inexpensively duplicated for producing identical dies in other plants.



TWO DIFFERENT-SIZED stub eyes are bored simultaneously in this machine. Three of the four stations on a vertical turntable are used for loading, rough boring and finish boring. The fourth station is idle. Both boring heads (below) use throwaway inserts. The head at the left has six cutting edges and cuts to dead center; the head at the right has four tools. The triangular inserts are indexed after 100 workpieces have been produced, eliminating a 5-hour tool grind required after every 80 pieces under the method previously used. The heads rotate at 300 rpm and are hydraulically fed at 10 to 12 ipm. The machine was designed and built by American Coleman Co.; the boring heads by Kennametal Inc.

## TOOLS at work



# curing under pressure
## *improves plastic tooling*

**By Donald E. Dutt and Howard S. Mather**
Tool Development Service
Manufacturing Services
General Electric Co.

**When cast plastic tools are cured under air pressure, they have greater accuracy and improved density. The authors show how silicone rubber molds—also cured under air pressure—are used in the production of these tools. Production examples are illustrated.**

**Fig. 1. Radio battery case produced by pressure casting. Mold cavity (right) is produced in silicone rubber from model at left.**

PRESSURE CURING, a relatively new technique, is now being successfully applied to the fabrication of plastic tooling. In this process a room temperature vulcanizing liquid-silicone rubber (RTV) is utilized to make a mold from a given master or model. The mold obtained by this process is then utilized to cast any desired number of epoxy resin parts. Bubble-free and of uniform density, the parts are near-perfect reproductions of the original model, *Fig.* 1. The same pressure curing technique is used in making cast-epoxy plastic tools.

Key to the success of this process is the use of air pressure while curing the mold. In casting, liquid silicone is poured over the master at room temperature and cured in a tank at air pressures between 50 and 80 psi. As a result of the pressure, the mold material is compacted onto the model and an accurate cavity is obtained. Density and flexibility are improved and there are no bubbles trapped in the plastic.

The setup for casting and curing a silicone rubber mold or an epoxy casting is made on a portable wood or metal tray, *Fig.* 2. This enables the operator to transfer the setup from the pouring area to the pressure tank. In those instances where epoxy plastic is cast in RTV molds, the mold is placed in the tank immediately after pouring. Pressure equal to that used to cure the mold is established and maintained throughout the entire cure cycle. If the original model is a relatively thin hollow shell, it is necessary to drill holes in the tray to equalize pressure and prevent distortion.

In most cases, standard paint pressure tanks are satisfactory for pressure curing, *Fig.* 3. These can be purchased complete with air gages and pressure relief valves in sizes suitable to the user's individual requirements. These tanks are manufactured according to codes specified for industrial pressure tanks. However, should it be necessary to build

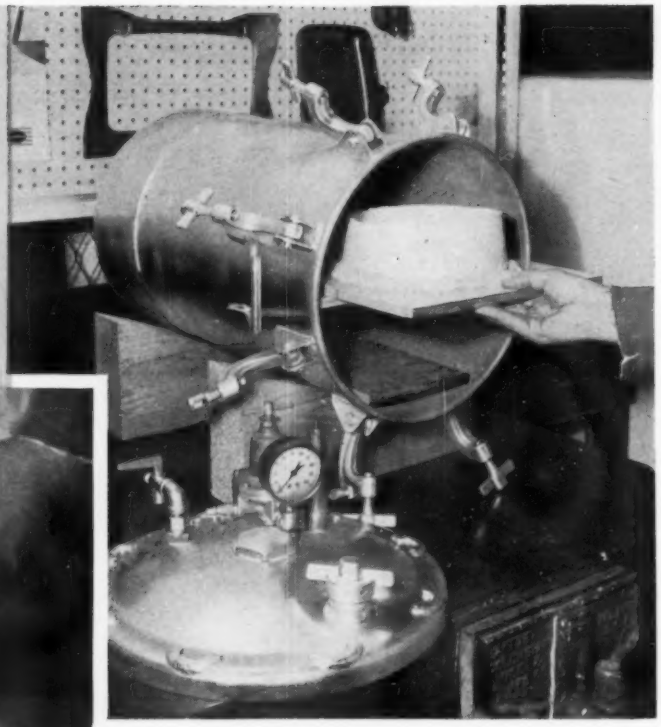


**Fig. 3. Loading the pressure tank. Commercial paint tanks of this type are ideal for pressure-casting applications.**

**Fig. 2. Pouring an RTV mold. Setup is made portable for manual transfer of the mold to the pressure tank.**

special tanks for large or unusually shaped jobs, all safety rules regulating the design of pressure vessels must be applied.

Pressure-cast RTV molds show a significant improvement over other flexible mold materials in reproducing engineering samples. As an example, GE engineers use the process to cast switch cases in transparent plastic as a means of viewing the switch mechanism in operation. They also find it useful in eliminating high costs when a comparatively large number of machining operations is required. For example, in the manufacture of radio case prototypes, *Fig.* 1, pressure casting is useful in producing thin contoured sections. In the past, these have been machined from solid blocks of plastic, but — because several prototypes of each model are required — machining costs have been high. Through use of pressure casting, it is now possible to eliminate all machining except that required for the model. RTV molds taken from the model make it possible to cast any number of prototype cases accurately and inexpensively.

Another good example of the economies and accuracy inherent in pressure casting is seen in the fabrication of complex pellet trays. Used for locating germanium pellets during manufacturing operations, the trays are fabricated from solid blocks of plastic, 5½ inches square by ¾ inch thick. Complicating the machining problem is the fact that 700 pockets for holding the pellets must be milled into each tray. These measure 0.078 x 0.020 inch. To expedite fabrication of the trays and cut costs, GE engineers make only one tray and, using it as a model, accurately cast the remaining trays. In one case involving an order of 24 trays, costs were cut from an estimated $4876 to $176 for a savings of 96 percent.

Using RTV rubber as a mold material, GE engineers have successfully cast a phonograph record that plays with virtually the same fidelity as the original. Although this experiment cannot be construed as a prelude to new manufacturing techniques in the record industry, it is an excellent testimonial to the accuracy of pressure-cured plastic castings. This development can, and undoubtedly will, serve a growing need in those sections of industry where high-fidelity mold reproduction for precision plastic tooling is required.

# Stampings for the Space Age . . . *by explosive forming*

**By G. C. Throner and I. Lieberman**
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**Explosive forming is emerging as an inexpensive and highly efficient method of metalworking. Correctly applied, it can accomplish forming operations that are impossible by pressworking.**

**Fig. 1. An explosive forming die. Workpiece shown is a missile component.**

RESEARCH recently conducted by Aerojet General Corp. has disclosed new possibilities for forming magnesium, steel and the superalloys by explosive forming. Initial research, started in 1958, was concentrated on the forming of 2-inch and 4-inch diam elliptical domes from materials such as hot-rolled steel, AISI 6434 and 4340 steels, and 6 Al-4 V titanium. Magnesium—normally considered unformable except when heated—was explosively formed in the cold condition in small-scale tests with a 2-inch diam die.

Eventually the research was extended to tests with a 24-inch diam die as a means of examining other materials in a wider range of thicknesses. The feasibility of producing domes in the 24-inch die was rapidly demonstrated and the research was continued in a full rocket engine diameter of 54 inches, *Fig.* 1. The 54-inch domes were explosively formed in a 1.6:1 elliptical contour and have since been fabricated in a variety of materials and thicknesses. For example, high nickel-chrome steels have been formed into domes from blanks ranging in thickness from 0.040 to 0.500 inch. Aluminum alloys have been forged in thicknesses up to 4 inches. These domes have met inspection requirements and qualified for further processing for eventual use on flight vehicles.

One of the more perplexing problems encountered in forming full-size domes was the phenomenon of wrinkling in the peripheral areas. This difficulty was largely overcome by redesign of the hold-down pressure plates and by proper shaping of the explosive charge.

In explosive forming, considerably greater deflection is obtainable in one operation with work-hardening materials than is possible in conventional drawing operations. For example, 54-inch steel domes will normally require four to six separate draw operations with annealing between each draw. Explosive forming permits the complete forming and final sizing to be performed in just two operations. A stress relief of one hour at 1200 F is applied between the two explosive operations, but no annealing is required. For comparison, in the draw process, each annealing operation takes from four to eight hours at 1400 F.

It is also observed that the thickening and thinning pattern in an explosively formed blank differs significantly from the pattern produced by conventional drawing. The difference can be attributed to the friction that exists between the punch

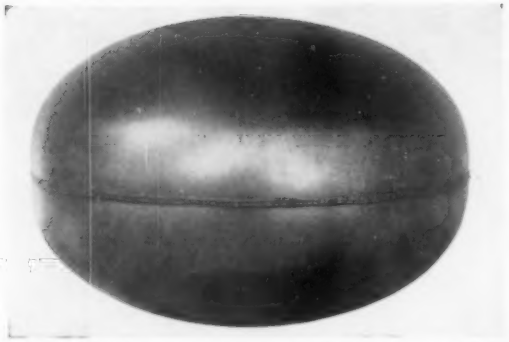

**Fig. 2. Welded pressure vessel. This part was fabricated by welding two explosive-formed panels.**

and the blank in conventional drawing. This friction is lacking in the free-moving condition of explosive forming. Unlike the conventional drawing process, in which the material is stretched from its original blank, explosive forming may force the finished part to assume an area smaller than the original blank. The resultant metal flow may cause some of the metal to assume a greater thickness than its original blank gage.

In an explosively formed dome, the metal is thinnest at the apex and gets progressively thicker approaching the periphery. In conventionally drawn panels, most thinning occurs in the knuckle radius of the formed piece. Complete elimination of thickening and thinning can be accomplished in explosive forming by proper preparation of the blank or by suitable shaping of the explosive charge. Of the two alternatives, the second is preferable. By shaping the charge, the designer is able to utilize the pressure wave for deflecting the material in the appropriate area and at the correct time in the forming sequence.

High-speed photographic observations indicate that under ordinary explosive forming conditions with open dies, a 32-inch-diam workpiece is deformed in 1 to 2 milliseconds. Average velocity of deflection is on the order of 400 to 800 fps. However, initial velocity of the blank may be as high as 1000 fps. These velocities will be a function of the charge, blank material and thickness.

All of the common steels including the stainless compositions, titanium and its common alloys, and many aluminum alloys have been successfully formed explosively. High-strength steels such as Tricent, Vascojet-1000, and AMS-6434, and alloys such as Unitemp M-252, are among the materials that pose problems in conventional forming, yet have been successfully formed explosively.

**Facilities:** Basic equipment required for explosive forming consists of a forming tank, buildings for storage and assembly, a lifting device, and a personnel barricade. State and local regulations are the determining factors on area location. Size of area and equipment capacity are determined by the size of material to be formed, the explosive charge and the rate of production required. Other facilities such as multiple forming tanks, assembly lines for die assembly and explosive-charge preparation can all be incorporated within the basic equipment when production schedules or area dimensions require or permit.

Facility and equipment investments are substantially less than those required for fabrication of equivalent parts by conventional methods. On the other hand, the availability of personnel with explosive and safety know-how and the restrictions on locations imposed by safety codes offer some limitation to adoption of the process. However, a basic advantage of the explosive fabrication process lies in the ease of duplication of facilities when quick increases in production are required. It is unnecessary to have large, expensive presses in the industrial defense reserve for fabrication of rocket chamber closures. Explosive forming areas can be made readily available as the need arises. Instead of concentrating production into small areas where

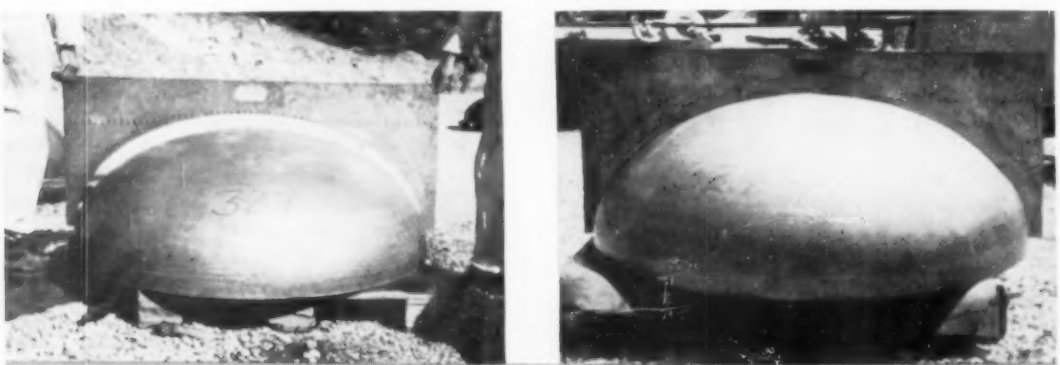

**Fig. 3. Template layup showing contour condition of part before and after explosive truing.**

the large tooling is located, explosive forming areas can be installed near a larger number of fabricators and used in conjunction with the production of the complete defense item. In this way many of the restrictions on production imposed by large and expensive tooling can be countered through utilization of explosive forming.

**Detonation:** When an explosive material is detonated, a high-velocity detonation wave occurs. Behind this wave, which moves in the velocity range of 5000 to 28,000 fps, depending upon the explosive employed, the explosive is converted to a high-temperature, high-pressure system of gases. These gases exert large and instantaneous force upon any medium in contact with the system and provide the pressures required for explosive forming.

In the explosive forming, forging, and truing processes, the explosive as well as the workpiece is submerged in a liquid. When the explosive is detonated, the pressure generated exerts a force in two ways. First, a violent and rapidly moving shock wave passes from the explosive surface through the liquid medium to the workpiece. Second, the liquid medium is accelerated by the expanding gas system. Any movable object in the medium will also be accelerated. Because the velocity to which the workpiece is accelerated depends upon the physical arrangement of the system, it can be controlled by the medium and by the proximity of the charge to the workpiece. The extent to which it can be controlled surpasses that of the more conventional forming processes.

Many explosive materials suitable to the explosive forming, forging, and compaction processes are available. The range of properties and explosive characteristics they exhibit, as well as the form in which they are obtainable, permits great flexibility in the design of the metal-forming processes. These are obtainable in various physical forms, such as granules, flexible sheets, and plastics. In addition, liquid and gaseous explosives are also available. Some explosives can even be obtained in cord form with as little as two grains of explosive per lineal foot to more than 100 grains per foot. The proper selection of the explosive permits designers to control forming pressures which may range from a few psi to four million psi. Proper design of the physical and geometrical form of the explosives is also important because it affects the amount, location and application of energy.

**Explosive Truing:** This is a related process in which explosively generated pressures are applied to a previously formed part, *Fig.* 3. The preformed part which may have been formed by either explosive or conventional techniques is explosively trued to correct any dimensional deviations in diameter or contour. Much of the work currently described as explosive forming could be more correctly designated as explosive truing.

**Fig. 4. Workpiece forged by explosive forming. This part is 4 inches thick and 43 inches in diameter.**

Explosive truing as a production process has proved extremely valuable when used in conjunction with conventional fabrication methods. For example, the drawing of thin-walled (0.080 inch) 54-inch diam rocket chamber heads with a conventional press results in a high rejection rate because of a lack of contour trueness to print specifications. Failures are also caused by wrinkles that propagate into the head from the flange area. These result from difficulties in controlling hold-down pressures during forming. In addition it has been found impossible to meet dimensional requirements in the mouth area which mates with the rocket cylinder.

These deficiencies have been corrected through use of explosive forming. In the example shown in *Fig.* 1 a preformed unit was placed in an explosive-forming die machined to correct contour and diameter, and an explosive charge was detonated within the cavity. Application of explosive truing to thicker (0.250 inch and 0.350 inch) domes which were not wrinkled but failed to meet dimensional tolerance, was equally successful.

In another instance, explosive truing demonstrated its value by reducing tooling costs of conventional draw operations. A number of rocket heads were required in three thicknesses from 0.080 inch to 0.350 inch with all units having the same outer diameter at the mouth. In conventional drawing, a new set of punches is required for each set of domes of a given thickness. Through use of explosive truing with conventional drawing, all domes were produced with the punch for the 0.350-inch dome. The 0.250-inch domes were undersize by 0.100 inch and the 0.080-inch domes were undersize by 0.270 inch. All domes were explosively trued in a female cavity to the required outer diameter. In this way, required dimensions were attained and tooling costs were reduced by approximately two-thirds.

Explosive truing is also valuable when additional processing of a formed part, such as heat treating or the welding of rings or bosses on the unit,

causes warpage or distortion. Deviations in contour of as much as ¾ inch, introduced by weld heat, have been corrected.

**Forming and Forging:** Like explosive truing, the explosive forming and forging process has demonstrated its value in economical production fabrication, *Fig.* 4. Blanks of high-strength AISI 4340 steel ranging from 0.040 inch thick to 0.500 inches thick and aluminum alloys up to 4.0 inches thick have been successfully formed. Mouth diameters of 54.000 ±0.010 inch are maintained with comparative ease. Contour deviation from the print dimension is maintained at ±0.025 inch or less where the callout is ±0.060 inch. Thickness variations within a formed dome can be closely controlled by making the blank thicker in areas which are expected to thin and thinner in areas which will thicken during forming.

In dome forming, 10 percent thinning can be expected at the apex because of stretching of the material in this region. Maximum thickening, which occurs in the circumferential regions of the draw flange, is approximately 10 percent and is caused by the action of the blank in drawing away from the larger peripheral areas while being compressed into a smaller area.

Although the pattern of thinning to thickening is not linear, it can be considered linear for preliminary approximations. When extremely close tolerances are required, more precise patterns must be calculated. The ability to correct the blank for thinning and thickening is more readily available in explosive forming than in conventional drawing because of the shock wave pressures and associated gas bubble pressures. These are exerted against the blank and behave much like a frictionless punch. As a result the blank material flows freely into the die cavity without excessive stretching between adjacent regions. In conventional draw operations contact between the punch and the blank material causes stretching between the contact and flange areas.

**Fig. 5. Explosively compacted nozzle. This component was fabricated from tungsten-nickel powder.**

**Explosive Compaction:** Research into the explosive compaction of powdered metals is a natural follow-up of explosive forming, *Fig.* 5. The extreme pressures and high rates of loading available from high explosives preclude the need for bonding materials that reduce the strength and density of compacts made by more conventional techniques. Materials that have been investigated for suitability for explosive compaction include zirconium oxide, tantalum, tungsten, molybdenum, tungsten carbide with binder, tantalum carbide, beryllium and other refractory metals.

Densities achieved by explosive compaction of these metals closely approach cast densities. Green compact densities normally range from 88 to 92 percent of theoretical. After sintering, typical compact densities, expressed as percentages of theoretical density, are tungsten, 92 percent; tantalum, 97 percent; molybdenum, 95 percent. The compacts from which these figures were obtained were produced by straight ram compression. Double action presses have also been found effective but it is important that the two explosive charges function simultaneously.

The primary advantage of explosive compaction appears to be the availability of very high pressures for a minimum expenditure in machine cost. Presses and dies costing hundreds of thousands of dollars can be duplicated in their effects by small, reusable units employing explosive charges that cost only a few dollars.

**Summary:** Explosive forming and truing is rapidly gaining acceptance in industry as a standard method of metalworking. The process has its place along with other processes in solving some of the more difficult deep drawing problems.

For applications requiring large formed pieces, difficult to handle materials, and quick, economical fabrication of prototypes, explosive forming has become a competitive process. In some instances, it is the only feasible process to use. In the future, explosives will become even more important as a source of energy in the metalworking industry. Furthermore, as a by-product of this technique new materials will be developed and the physical characteristics of some of the more familiar compacted materials will be significantly improved.

From a paper presented at the ASTME Seminar "Creative Manufacturing." Single copies of the complete paper are available without charge from Society Headquarters.

# MILLING
# High-Strength Alloys

DIFFICULTY in the milling of space-age components has increased as a result of the increased hardness and strength of the workpiece and the use of high nickel and high cobalt alloys. This, coupled with the intermittent impacts of cutter teeth leads to vibration. Ridigity is essential, and on the very hard alloys, the fixed bed type of milling machine generally has an advantage over knee and column type machines.

On most of the alloys it is necessary to climb mill to obtain reasonable tool life. For this reason the machine should have a blacklash eliminator. Also, tool life usually is relatively short and a quick tool change arrangement is desirable. A wide range of feeds and spindle speeds should be available in order to select an optimum for milling the very hard materials. Power requirements exclude the use of light-duty milling machines almost entirely. For the milling conditions indicated in the accompanying tables, between one and two horsepower per cubic inch per minute is required. Speeds and feeds indicated in the tables are for carbide tools, except for end milling, which is based on use of T-15 high-speed steel tools.

Derived from Vol. 4, "Machining Characteristics of High Strength Thermal Resistant Materials," published by Curtiss-Wright Corp. for the U. S. Air Force.

**Table 1—Face Milling***

| Alloy Group | Treatment† | Hardness | Speed (fpm) | Feed (ipt) |
|---|---|---|---|---|
| Martensitic low alloy steel | QT | 35-40 $R_c$ | 200-500 | 0.005-0.008 |
| Martensitic low alloy steel | QT | 50-55 $R_c$ | 75-150 | 0.004-0.006 |
| Hot work die steel | QT | 35-40 $R_c$ | 150-500 | 0.005-0.008 |
| Hot work die steel | QT | 50-55 $R_c$ | 75-150 | 0.004-0.006 |
| Austenitic stainless steel | ST or STA | ---- | 60-125 | 0.008-0.015 |
| Martensitic stainless steel | QT | 35-40 $R_c$ | 150-300 | 0.008-0.012 |
| Martensitic stainless steel | QT | 40-45 $R_c$ | 125-200 | 0.006-0.008 |
| Precipitation hardening stainless steel | Ann | 320 Bhn | 125-150 | 0.006-0.012 |
| Precipitation hardening stainless steel | HT | 444 Bhn | 125-150 | 0.004-0.006 |
| Nickel base high-temperature alloy | ST or STA | | Carbide cutters not recommended | |
| Cobalt base high-temperature alloy | ST | | Carbide cutters not recommended | |
| Titanium | Ann | 312 Bhn | 70-110 | 0.004-0.008 |
| Titanium | STA | 365 Bhn | 70-110 | 0.004-0.008 |

*Width of cut from 1 to 5 inches, depth from 0.050 to 0.150 inch.
†QT=quenched and tempered, ST=solution treated, STA=solution treated and aged, HT= hardened and tempered, Ann=annealed.

## Table 2—Side Milling*

| Alloy Group | Treatment† | Hardness | Speed (fpm) | Feed (ipt) |
|---|---|---|---|---|
| Martensitic low-alloy steel | QT | 50-55 $R_C$ | 140-170 | 0.004-0.008 |
| Hot work die steel | QT | 50-55 $R_C$ | 125-170 | 0.005-0.008 |
| Austenitic stainless steel | ST or STA | 321 Bhn | 80-130 | 0.007-0.012 |
| Martensitic stainless steel | QT | 40-45 $R_C$ | 175-250 | 0.005-0.010 |
| Precipitation hardening stainless steel | STA | 444 Bhn | 75-130 | 0.004-0.007 |
| ‡Udimet 500 nickel base alloy | STA | 360 Bhn | 15-25 | 0.005-0.010 |
| ‡Inconel 700 nickel base alloy | STA | 320 Bhn | 15-25 | 0.005-0.010 |

*Width of cut from 1 to 5 inches, depth from 0.050 to 0.150 inch.
†QT=quenched and tempered, ST=solution treated, STA=solution treated and aged, HT=hardened and tempered, Ann=annealed.
‡T-15 high-speed steel.

## Table 3—Slotting*

| Alloy Group | Treatment† | Hardness | Speed (fpm) | Feed (ipt) |
|---|---|---|---|---|
| Martensitic low-alloy steel | QT | 50-55 $R_C$ | 150-225 | 0.004-0.008 |
| Hot work die steel | QT | 50-55 $R_C$ | 125-225 | 0.004-0.008 |
| Austenitic stainless steel | ST or STA | 321 Bhn | 110-160 | 0.004-0.006 |
| Martensitic stainless steel | QT | 40-45 $R_C$ | 175-225 | 0.004-0.006 |
| Precipitation hardening stainless steel | STA | 444 Bhn | 100-150 | 0.003-0.005 |
| ‡Udimet 500 nickel base alloy | STA | 360 Bhn | 60-120 | 0.003-0.005 |
| ‡Inconel 700 nickel base alloy | STA | 320 Bhn | 60-120 | 0.003-0.005 |

*Width of cut from 0.250 to 1 inch, depth from 0.050 to 0.250 inch.
†QT=quenched and tempered, ST=solution treated, STA=solution treated and aged.
‡T-15 high-speed steel.

## Table 4—End Milling*

| Alloy Group | Treatment† | Hardness | Speed (fpm) | Feed (ipt) |
|---|---|---|---|---|
| Martensitic low-alloy steel | QT | 40-50 $R_C$ | 40-60 | 0.0005-0.002 |
| Martensitic low-alloy steel | QT | 50-55 $R_C$ | 50-75 | 0.001-0.002 |
| Hot work die steel | QT | 50-55 $R_C$ | 60-80 | 0.001-0.003 |
| Austenitic stainless steel | ST or STA | 321 Bhn | 30-50 | 0.002-0.004 |
| Martensitic stainless steel | QT | 40-45 $R_C$ | 50-70 | 0.0005-0.002 |
| Precipitation hardening stainless steel | STA | 444 Bhn | 65-75 | 0.001-0.002 |
| Udimet 500 nickel base alloy | STA | 360 Bhn | 30-40 | 0.001-0.002 |
| Inconel 700 nickel base alloy | STA | 320 Bhn | 30-40 | 0.001-0.002 |
| HS-25 cobalt base alloy | ST | 200 Bhn | 30-40 | 0.001-0.002 |
| ‡HS-25 cobalt base alloy | ST | 200 Bhn | 40-60 | 0.001-0.002 |

*Width of cut from 0.250 to 2 inches, depth from 0.050 to 0.250 inch.
†QT=quenched and tempered, ST=solution treated, STA=solution treated and aged.
‡Carbide cutters

# Productivity '61

## the ASTME Manufacturing Engineering Conference and Tool Exposition

**May 22-26** **New York City**

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## *EXPOSITION PREVIEW


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# Convention Is Recession-Breaker

"THE MANUFACTURING INDUSTRIES hold in their own hands the key to beating present and future recessions," ASTME General Manager Harry E. Conrad recently declared. In a few weeks 40,000 manufacturing engineers and executives will be wielding that key—greater manufacturing productivity—during the Society's 1961 Engineering Conference and Tool Exposition in New York.

"Along with most people close to the American economic scene," said Conrad, "the Society feels that one of the major reasons for the present recession is consumer resistance to the rising prices of manufactured goods." But with the advent of new manufacturing processes, new types of machines and equipment, and automatic controls and automation of all kinds, he explained, it is possible to virtually double the productive efficiency of many of America's manufacturing plants. This increased efficiency can enable companies to hold the prices of manufactured goods at levels that encourage consumer buying.

Also, the adoption of radically improved manufacturing methods and equipment will mean substantial improvements in the durability, attractiveness and quality of many manufactured products—an added set of incentives to spark increased consumer demand.

The ASTME 1961 Convention—Productivity '61—enters the recession-breaking picture as the answer to a communications problem.

"In this age of explosive technological development," stated Conrad, "new advances in manufacturing technology have come along in such diversity and at such a fast rate that most manufacturing engineers and executives have trouble keeping up with developments." Consequently, only a fraction of America's plants have put to work the tremendous recent advances in the field.

At the convention, manufacturing people from all over the nation will gather for a week-long program on technological innovations that can beat the recession by leading to higher manufacturing productivity. The focal point of the event will be a $15-million tool exposition in the New York Coliseum. On three floors of the sprawling facility in the heart of New York City, hundreds of manufacturers will display some 5000 exhibits, representative of the most advanced manufacturing equipment available today. Here will be machine tools, cutting tools, tooling, inspection equipment, automation devices—literally everything needed for up-to-date production. Many of the 700 items being shown for the first time at the exposition appear on the following pages.

During the Engineering Conference more than 50 nationally known experts on specialized phases of manufacturing will give illustrated talks on the latest developments in their fields—developments that, when applied, have the capability of cutting manufacturing costs in America by many millions of dollars annually. A preview of these engineering discussions appears in these pages.

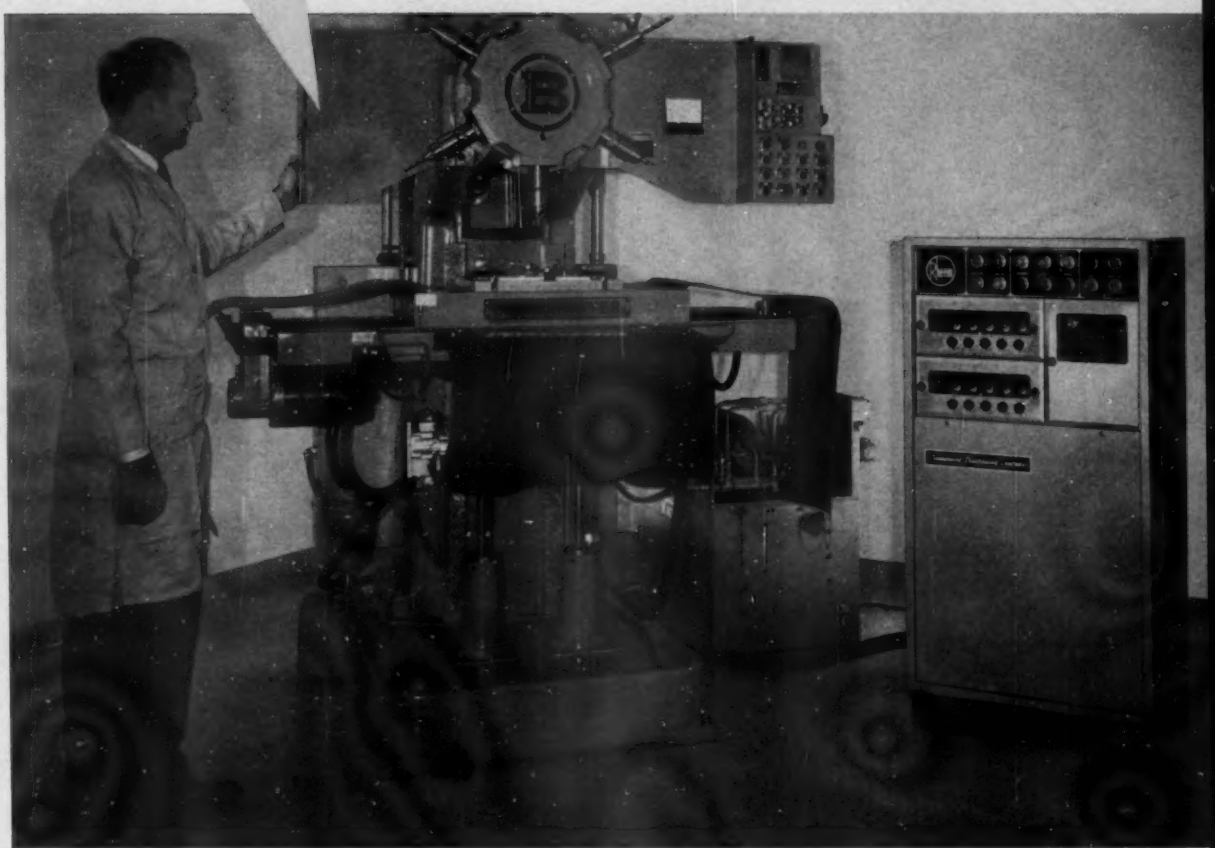
Leading off the conference is a two-day Surface Metrology Seminar on the newest advancements and future requirements in the fields of surface specifications and surface measurement techniques. Another highlight of the technical program is a one-day symposium devoted to new developments in metal removal.

On visits to nine of America's leading manufacturing plants, convention participants will view the latest and most modern production methods in action. Three Techtours exploring three new and challenging fields—manufacturing operations management, high-energy metalworking and numerical control—will feature engineering paper presentations combined with plant tours to see the operations discussed by the experts.

The product of ASTME's Engineering Conference and Tool Exposition is knowledge—knowledge that is power, power to beat any recession, power to raise the American economy to higher levels of sustained output, the power of productivity.

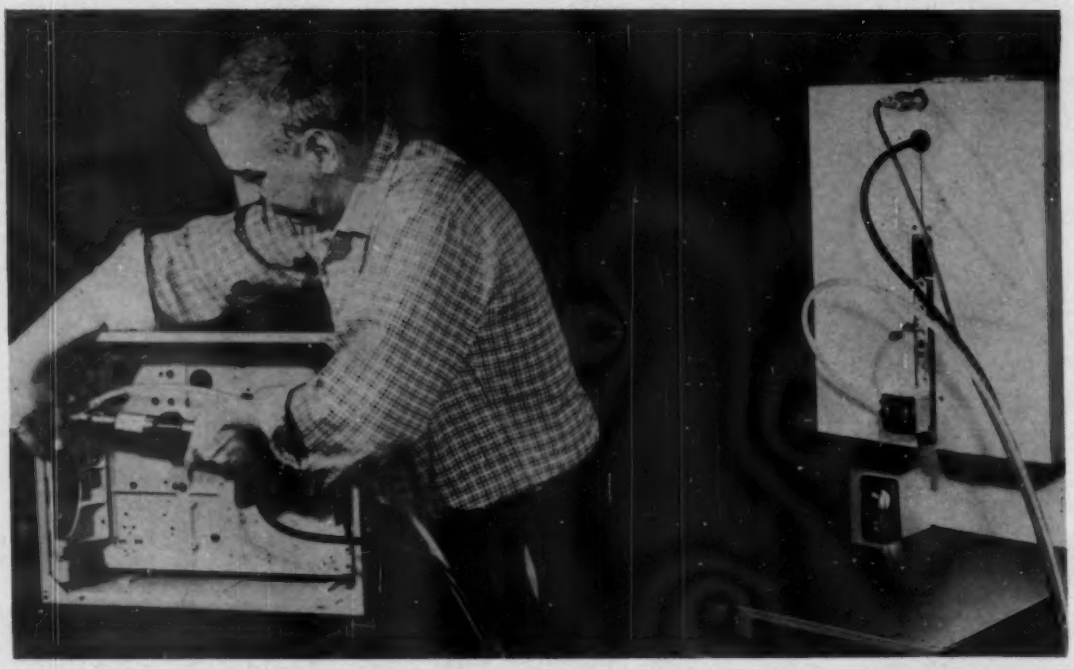
# Exposition Preview

**More than 5000 products . . .
will be exhibited at the ASTME Tool Exposition.
Some of these products are previewed in the
following pages.**

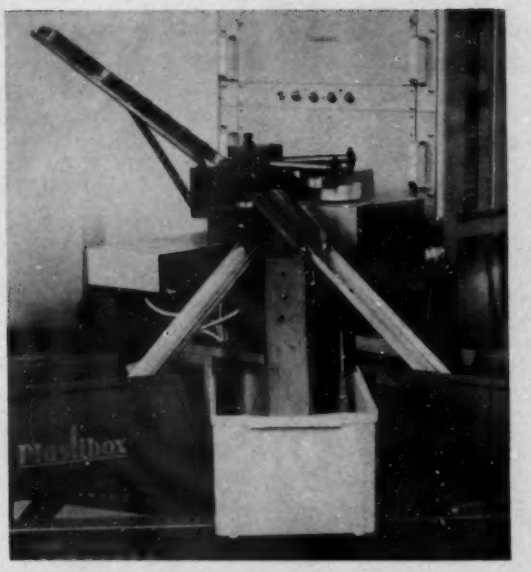


Productivity '61 is typified by the advances in numerical control. In this Rheem control unit numerical control in two axes is obtained without the use of special drawings. Dimensional information—programmed into a tape-preparation system in decimal form—is read by a photocell tape reader for control of machining.

Designed for high-speed assembly operations, this riveter punches a hole, inserts a rivet and completes a rivet-heading operation in less than two seconds. Its low weight (25 lb) allows it to be used as either a portable tool or in a stationary installation. When used as a portable tool, an overhead counterbalance supports the riveter's weight. This simplifies the operator's work and reduces fatigue. In operation all machine functions are controlled by a finger trigger and handgrip. ACF Industries.

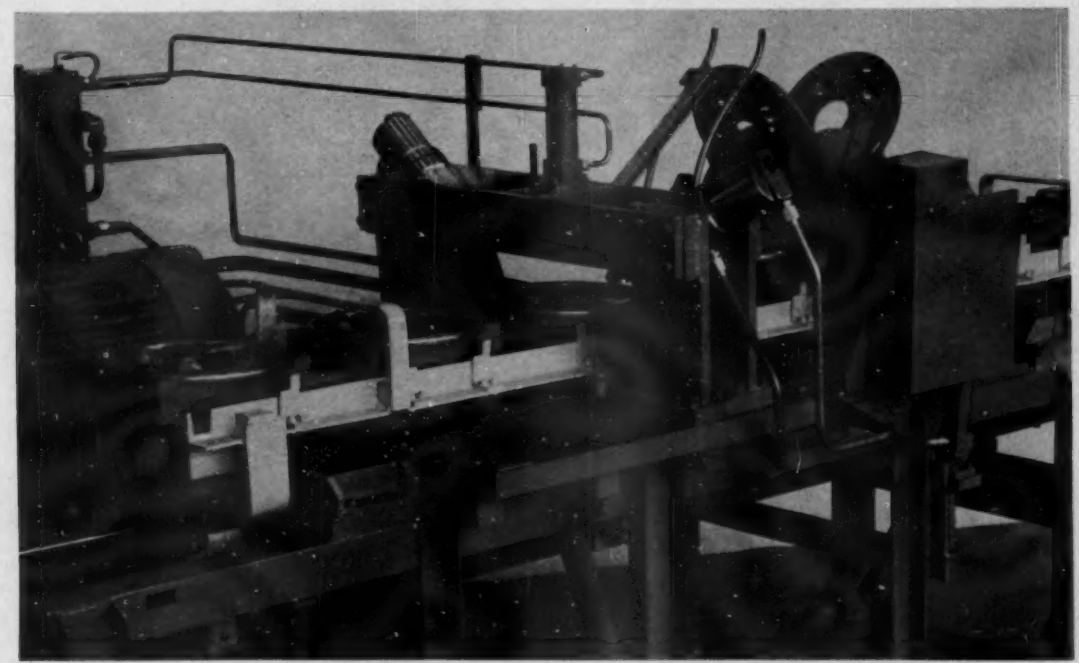


Automatic feeding and driving of setscrews is accomplished at a rate of 2000 per hour in this gun type feeder driver machine. The feeder orients the screws and feeds them through a flexible tube to a driving gun. The gun—air powered and adjustable—drives the screws to preselected depths or torques. All models can be operated as either stationary or portable units. The Bristol Co.



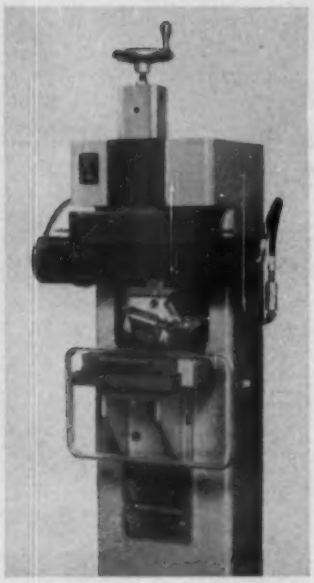
Dimension and density control is obtained by sorting parts according to weight in this check weighing system. Utilizing a high-speed spring balance, the system can inspect parts ranging up to 2.2 lb in weight at a speed of 60 per minute. In operation part transfer is effected by an integrated transport system that can be adapted to odd shaped components. Mettler Instrument Corp.

Electrical signals emanate from the indicator in this setup when pre-established tolerance limits are reached. These signals can be utilized to energize lights for visual indication of size or to actuate machine controls for automatic sorting and size control. In this application, the indicator is used to inspect germanium and silicon wafers during planetary lapping. Hamilton Watch Co.

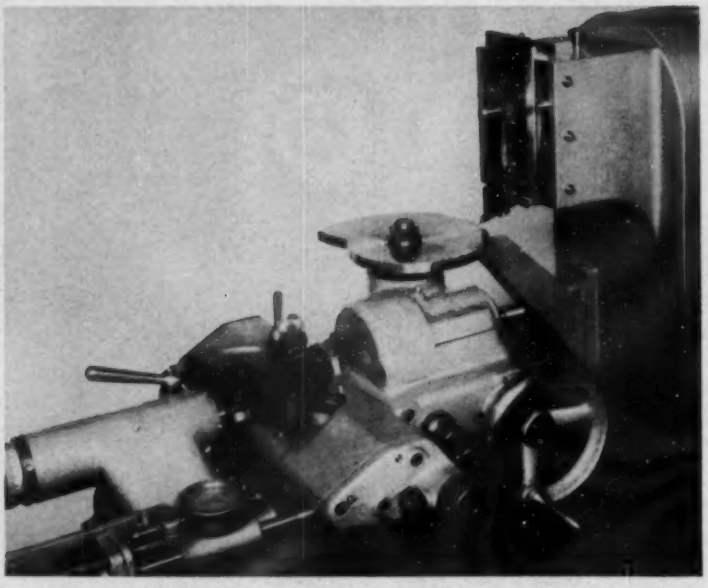


This walking beam transfer mechanism is designed to move parts from one press to another. It also inverts and pierces each part in transit. The two-dimensional transfer movement is effected by a portable mechanism actuated by a single hydraulic cylinder. All other functions—part inversion, clamping and piercing—are also accomplished hydraulically. Livernois Engineering Co.

# cost-cutting equipment

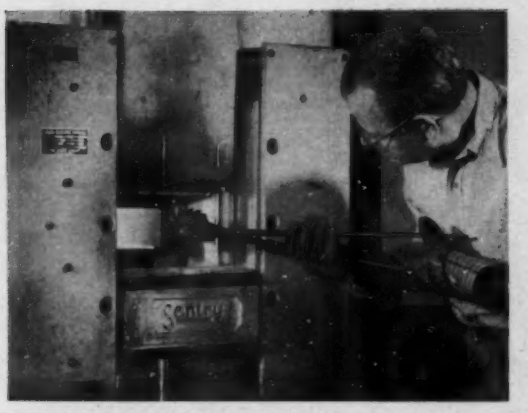


Representing a new approach to roll marking, this unit contains all operating mechanisms in the machine head. The head—comparable to that of a conventional press—provides both lateral and horizontal die slide travel. **Nobel & Westbrook Mfg. Co.**

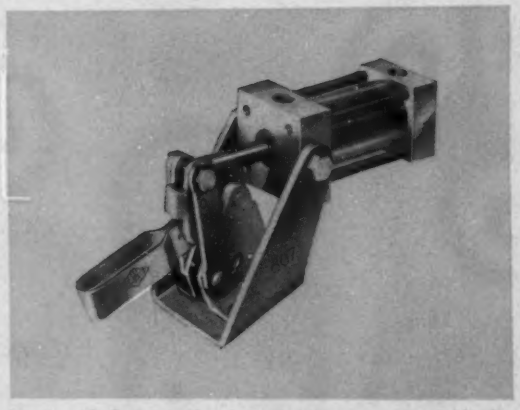


**Designed specifically for machining flat and bell cams, this machine combines the principles of milling and shaping. Functioning as a shaper, its machining head eliminates the angular surfaces which normally result from the use of end mills. This type of head also facilitates the machining of small radii which are unattainable in conventional milling operations. The milling device utilized in this design is a Strohm cam-milling attachment. Floor-space requirements are 16x24 inches. Hudson Automatic Machine & Tool Co.**

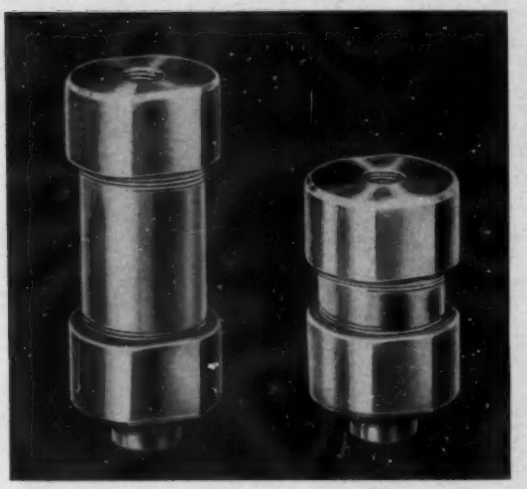
**Power, rigidity and controllable speeds and feeds are combined in this cutoff saw. Designed and built to utilize the cutting ability of tungsten carbide, the saw is shown cutting cold-rolled steel at a rate of 35 sq in per min. In the blade—designed specifically for this machine—carbide inserts are backed up by a spring-tempered steel band hardened to 45Rc. The DoAll Co.**



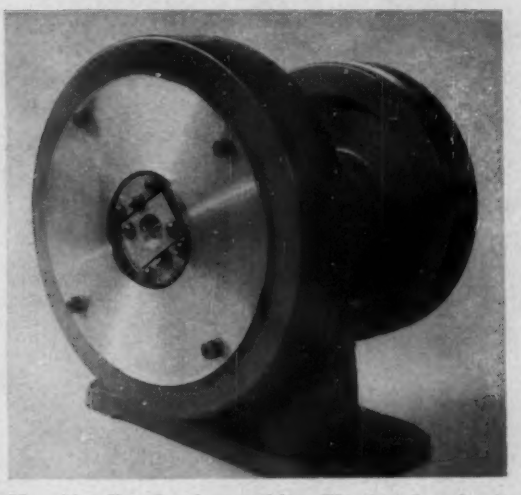
Designed for hardening HCHC and high-speed steels, this furnace provides a positive protective atmosphere for tool hardening. No adjustment or special operator skills are required and tools can be soaked to full hardness without surface deterioration. Century Co.



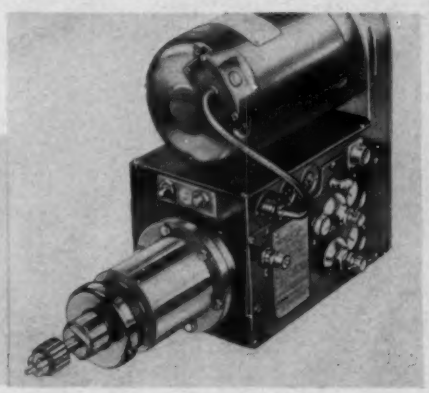
Designed for use in restricted areas, the unit illustrated makes use of a hydraulic cylinder to actuate a clamp. Useful for applications in which automated clamping or clamping by remote control is required, the unit operates under pressures of up to 250 psi. Detroit Stamping Co.



Reflecting the trend toward miniaturization, these small hydraulic clamps can be inserted into a 1⅛-inch diameter hole. Each cylinder develops piston thrust of 1900 lb. when coupled with a stock air-hydraulic booster. The end caps, which can be screwed on and off are intended for use as retainers. Wilton Tool Mfg. Co., Inc.

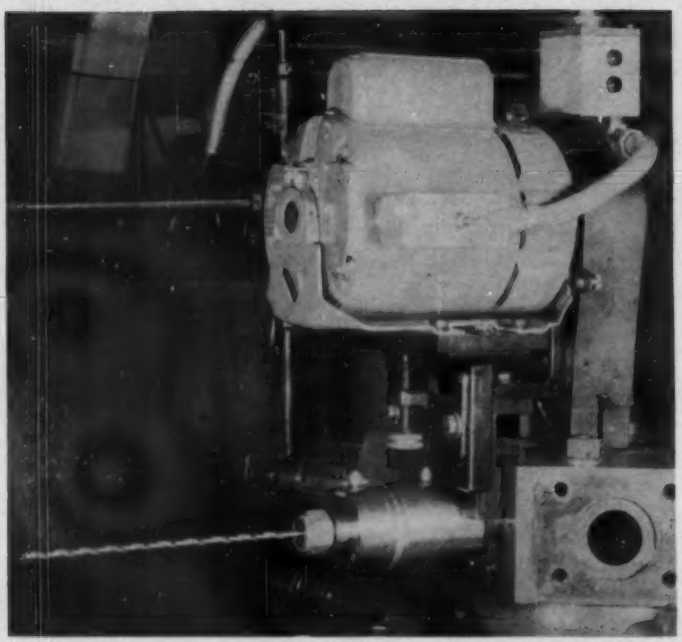


Movable dies in the machine illustrated make it possible to swage small parts to two different diameters. In operation, the closing action of the dies on the workpiece produces a sharp shoulder normally unattainable by swaging. Because no chip loss occurs, material costs are substantially less than those of machined parts. The Torrington Co.



Spindle speeds up to 15,000 rpm are possible in the drill unit illustrated. Other noteworthy design features are a controlled advance and retract mechanism actuated by air pressure, built-in controls and an interlock mechanism for coordinating the unit with related equipment in automated setups. The Dumore Co.

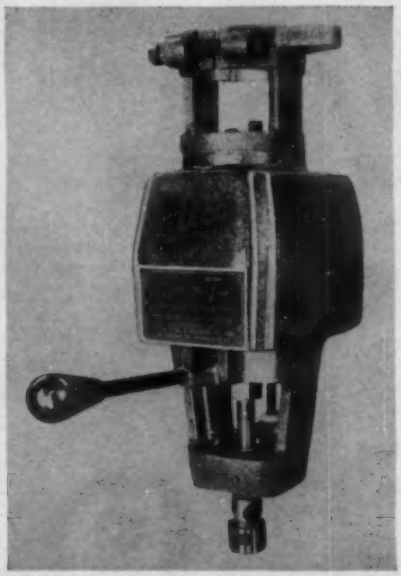
# drilling and tapping



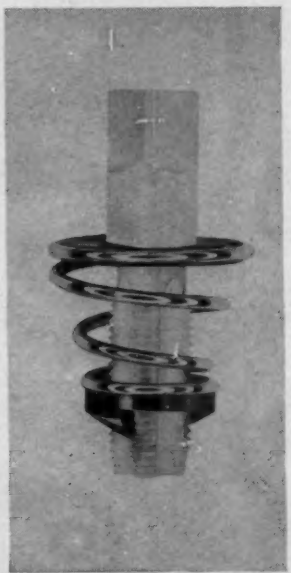
This attachment makes deep-hole drilling a part of conventional turret-lathe operations. Adjustable and self-contained, the unit fits into any hole on the turret without interfering with other stations. Increased safety is obtained by a rotating electrical power lead that prevents the entanglements which normally result from use of lead cords. Boyar-Schultz Corp.

Utilizing the principles of electrical-discharge machining, this disintegrator drills holes in hardened steel. Other uses include the removal of broken taps, drills and reamers. Jiffy Disintegrators, Inc.

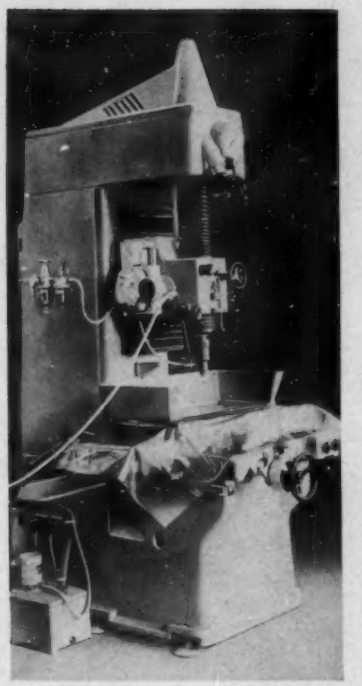
This turret-lathe toolholder will hold any size of shank up to its maximum capacity without bushings or sleeves. Drills, taps and reamers are held firmly in a V-block which can be adjusted to obtain correct spindle alignment. All parts are made of alloy steel and mating surfaces are precision ground. Boyar-Schultz Corp.



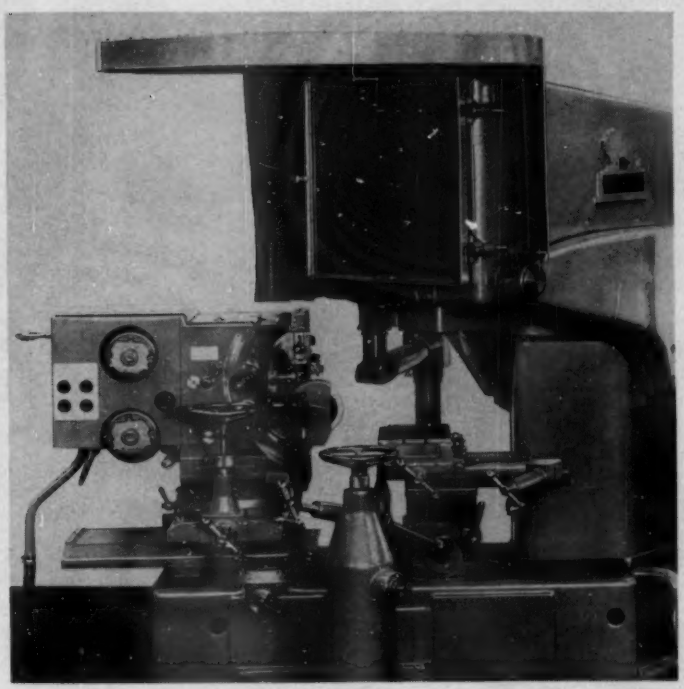
Adaptable to any drill press, the tapping unit illustrated has actuating, stop and depth control devices included as integral parts of its design. In operation, a hardened and ground leadscrew powered by a cone clutch absorbs the initial torque. Ettco Tool & Machine Co., Inc.



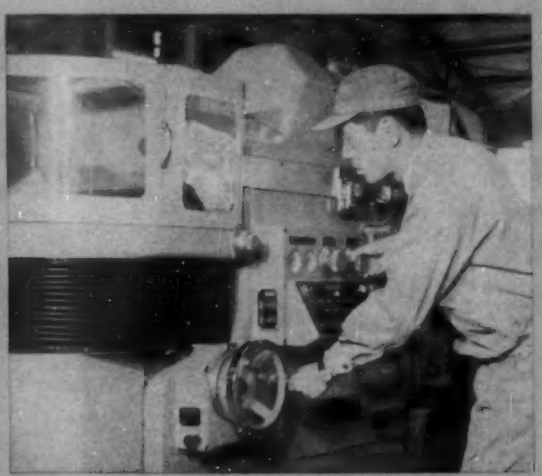
Tapping and deburring are combined in a single operation through application of this tool to any standard pipe tap. Adaptable to all taps, it deburrs during tool withdrawal. Vernon Devices, Inc.



In operation, this machine can function as either a jig borer or grinder. Light milling and grinding are also possible. A magnetic brake on the motor makes spindle stops instantaneous. Manex Machinery Corp.

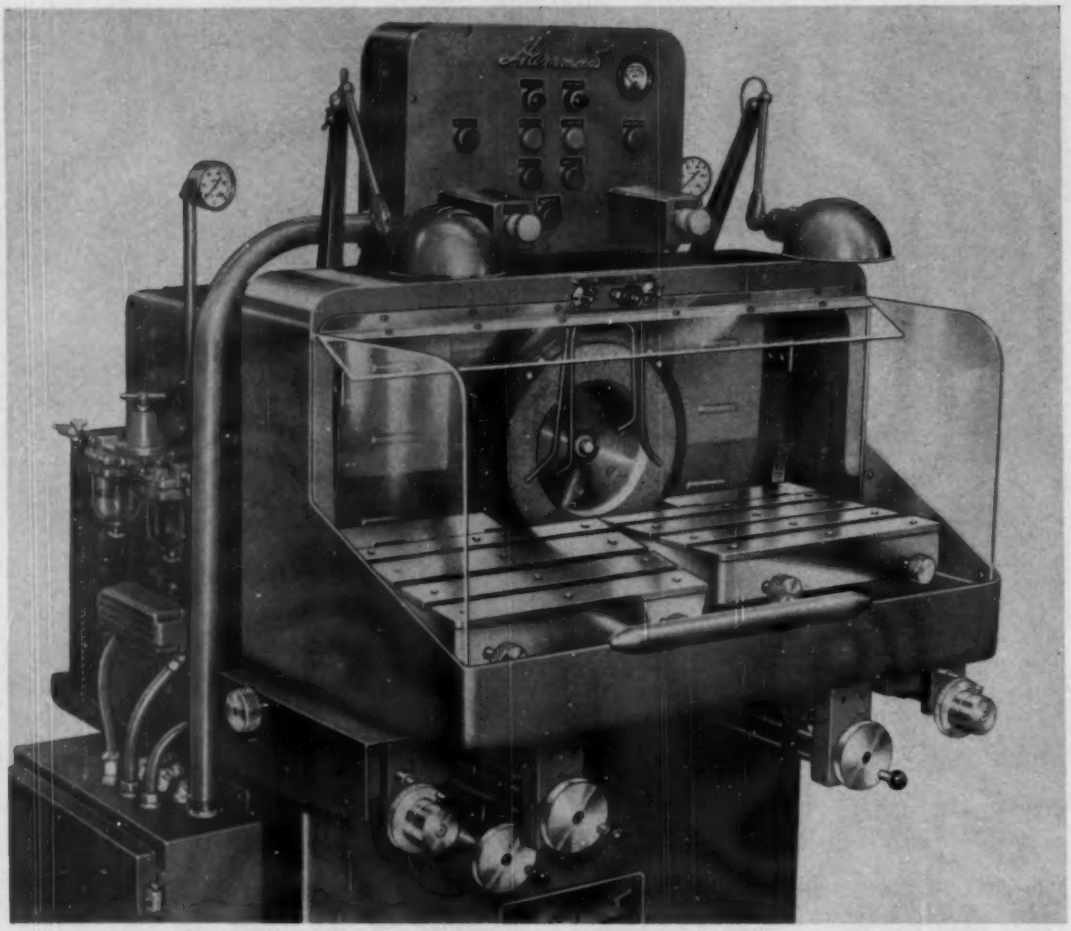


Designed for fast grinding of complex profiles, this optical profile grinder magnifies the workpiece to 50 diameters. Operator functions—simplified by automatic cross and longitudinal feed—are reduced to manual control of feed mechanisms in one direction only. In addition, lateral relief angles of 15 deg and axial relief angles of 35 deg allow for the grinding of compound angles within this range. Eric R. Bachmann Co., Inc.



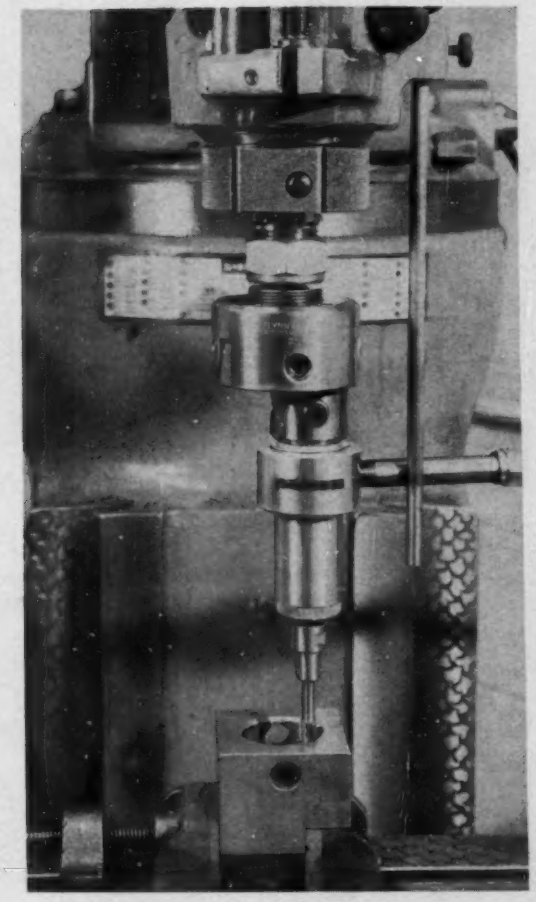
In this rotary surface grinder the wheel and table are coordinated to provide uniform grinding speed at all radii. Either flat or shallow conical work can be ground. A centrifugal cooling system prevents distortion and dissipates the heat generated by grinding. Mitsui & Co., Ltd.

# grinding and finishing

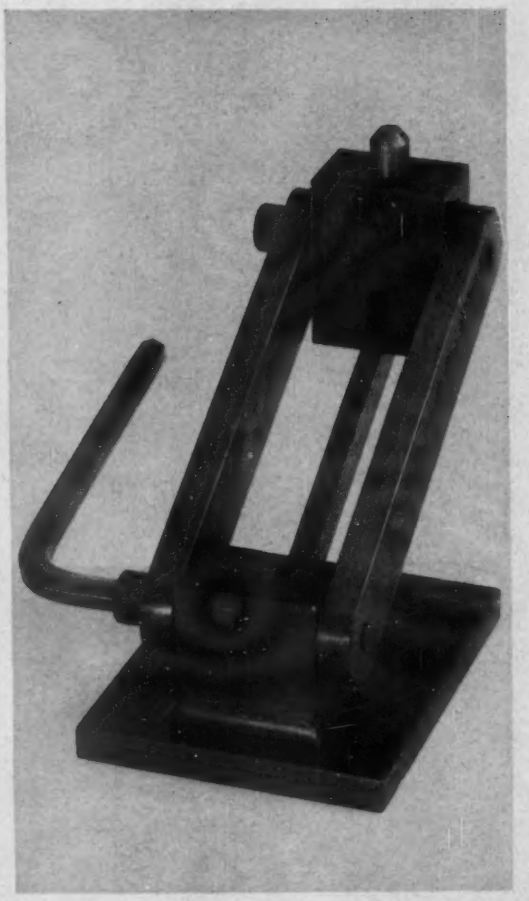


Electrolytic machining—the process of metal removal by electrolysis—is utilized to grind tungsten carbide, steel and superalloys in the Hammond grinder. This process is the reverse of plating in that metal is removed by electrochemical decomposition. Tilting tables on this machine facilitate the grinding of hardened parts to angles to 25 deg. Hammond Machinery Builders.

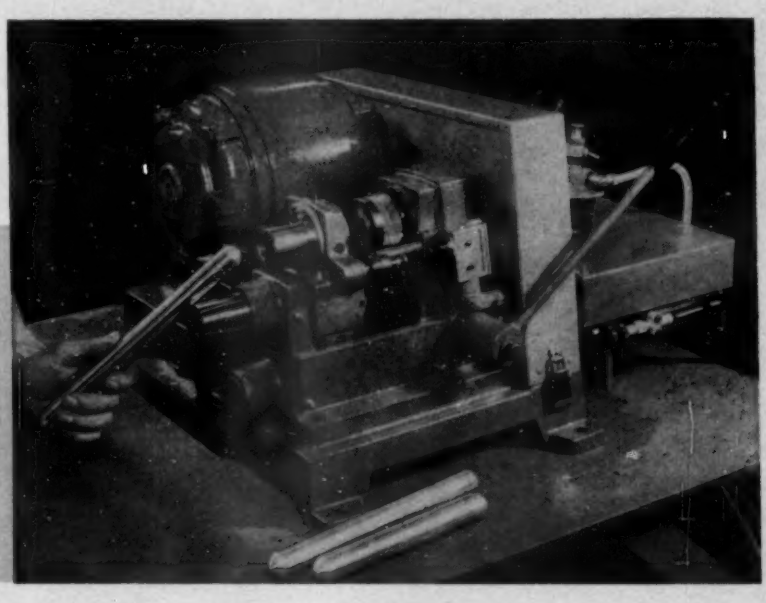
One or more layers of parts can be duplicated from a template in the belt-grinding machine illustrated. Template guidance and positioning relative to the belt is effected by the movable cross bar. Also useful for finishing shouldered punches and die sections, the grinder machines angles and drafts by indicator adjustment of the beam. Industrial Machines & Services, Inc.



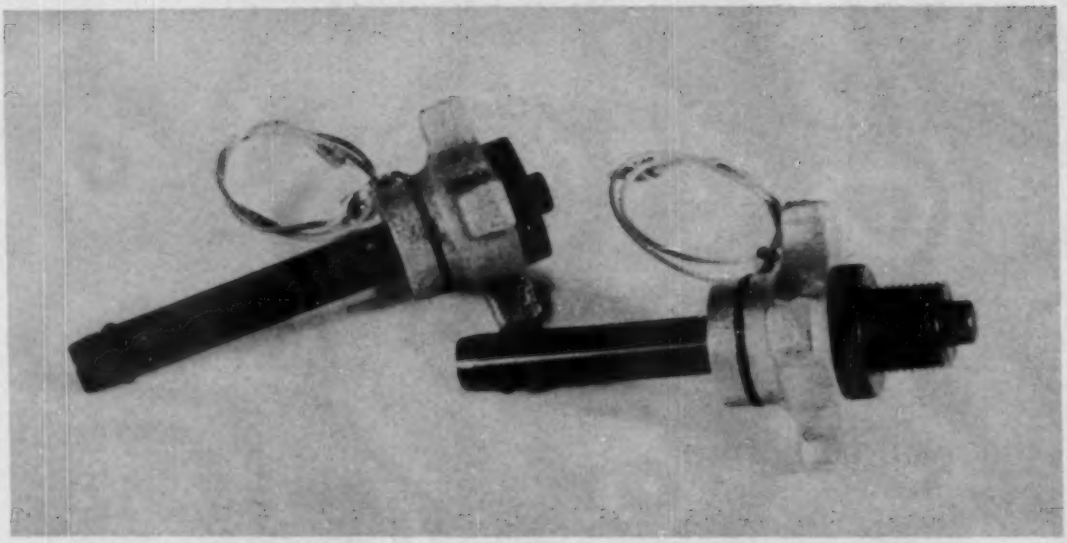
Adaptable to vertical and horizontal milling machines, this attachment enables a machine to jig grind holes or cylindrical components. Motors used to drive these attachments are of the rotary vane type. Speeds range up to 30,000 rpm with maximum runout of 0.0005 inch. Doeden Tool Corp.



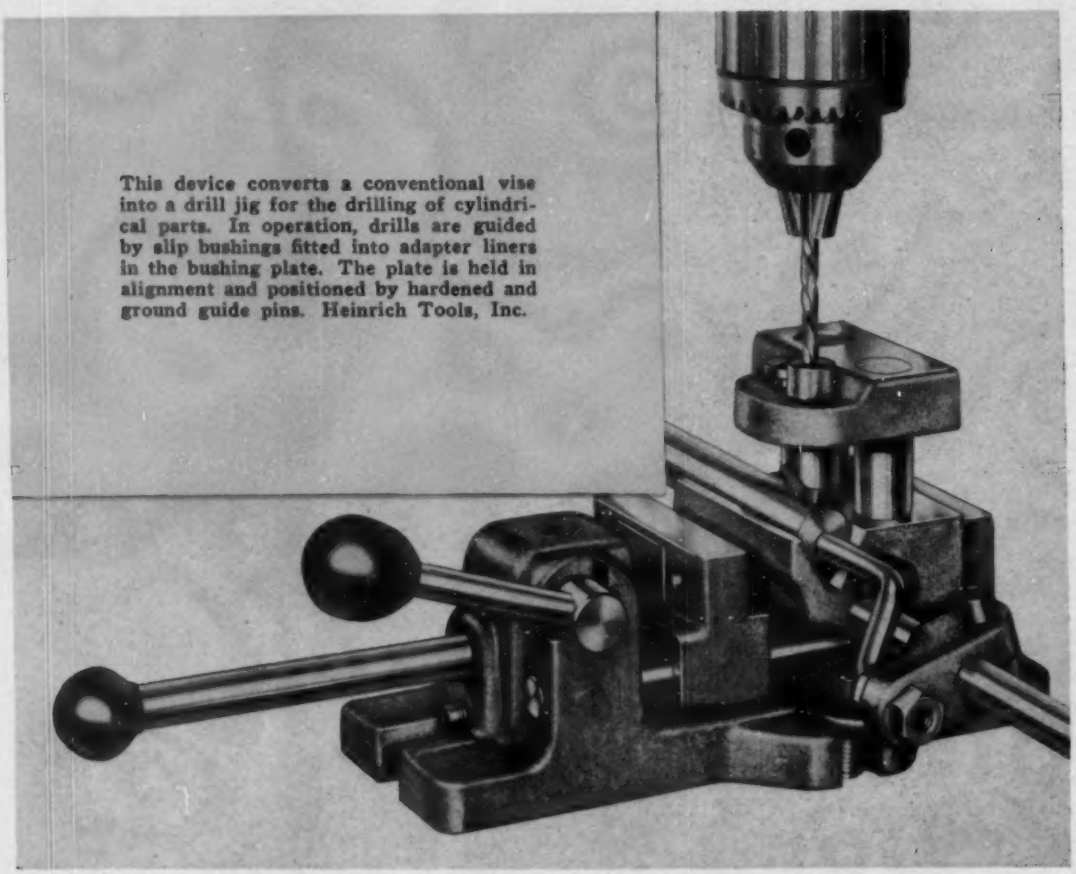
Designed for quick adjustment to any height within its range, this dresser is especially valuable when long sections are ground. Three support arms provide stability to the diamond during dressing and maintain the adapter in a vertical plane at all radial positions. Eastern Machine & Tool Co.



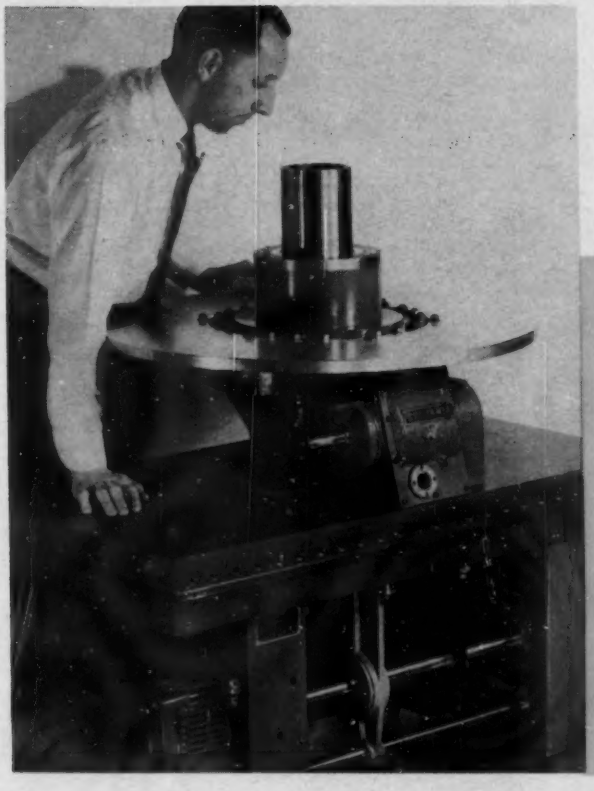
The spinning machine illustrated closes the ends of aluminum tubes to preselected shapes and sizes. This is accomplished by a rotating tool that induces plastic flow by frictionally heating the workpiece. Shapes obtained are determined by tool contours. Pines Engineering Co., Inc.



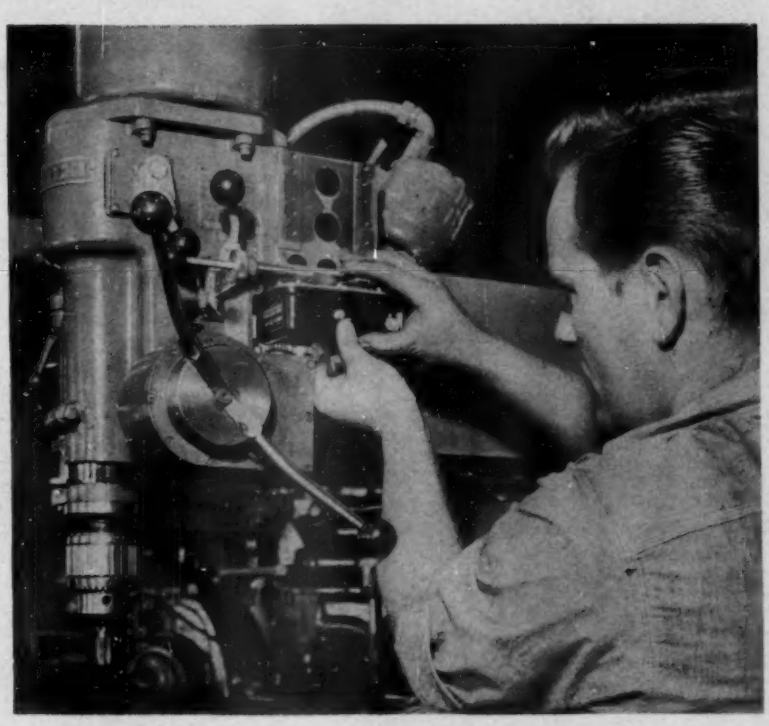
Protruding balls are utilized as locking devices in this quick-release pin. Release is effected by depressing a button at the end of the pin that allows the balls to retract into the body. Flexibility is obtained by one-half-inch adjustments in grip length. Carr Lane Mfg. Co.



This device converts a conventional vise into a drill jig for the drilling of cylindrical parts. In operation, drills are guided by slip bushings fitted into adapter liners in the bushing plate. The plate is held in alignment and positioned by hardened and ground guide pins. Heinrich Tools, Inc.

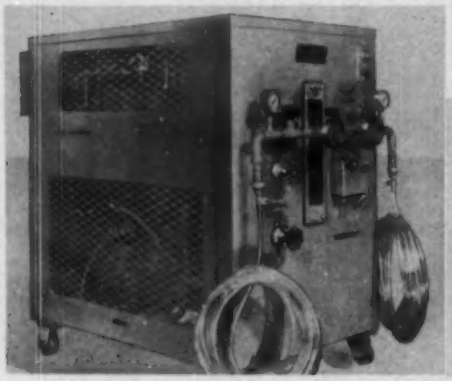


Built for automatic production and assembly applications, the Sylvania transfer machine indexes to desired positions without the use of shot pins or piloted tooling. Correct register of tooling stations is accomplished by a self-locking cross-over indexer mounted on a table-top base. Table motion is provided by two drive shafts and a motor drive. Sylvania Electric Products, Inc.



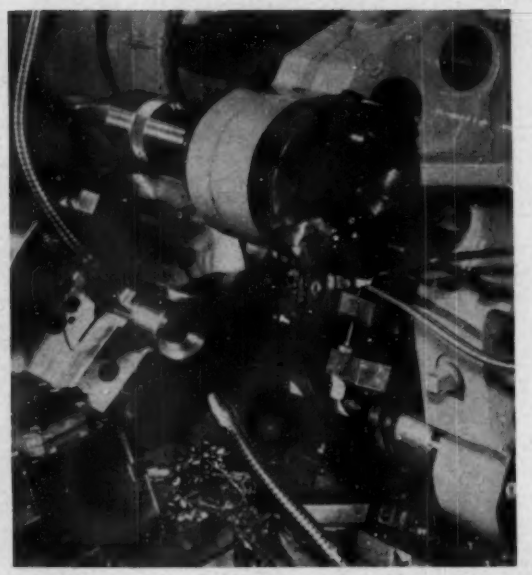
This drive provides infinitely variable speed with constant torque in a range from 0 to 2/3 of the input speed. Largest unit manufactured develops 450 in-lb of torque in a speed range of 0 to 80 rpm. In this application — typical of its use in the machine tool field — the drive is utilized as an integral part of a Johansson radial drill. The Zero-Max Co.

# machine tool components

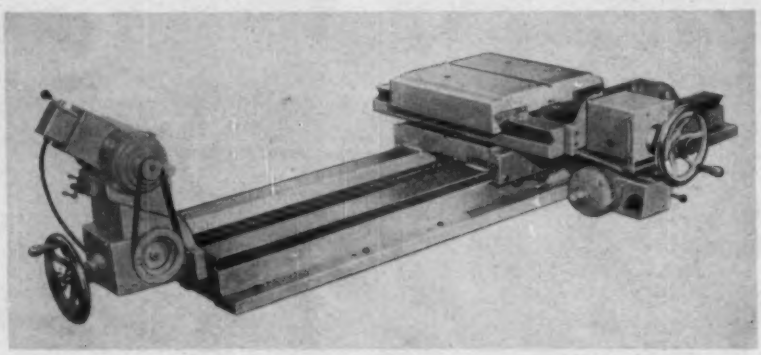


Developed for the electronics industry, this temperature stabilizer maintains temperature at plus or minus 2 deg of prescribed levels. Control is accomplished with a liquid heating system and an immersion type heating unit. These units are regulated by a two-stage thermostat. Coolant-flow rates are variable between 0 and 5 gallons per minute. Progressive Welder & Machine Co.

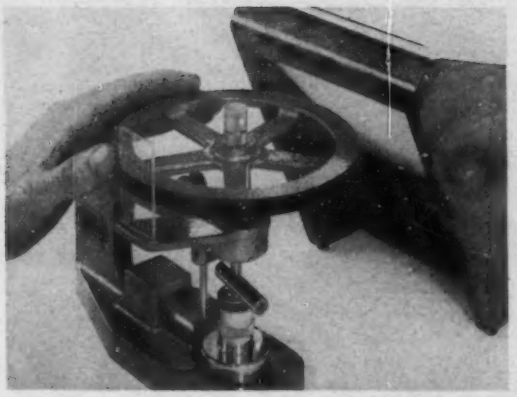
The unit illustrated prolongs tool life and increases cutting speeds in equipment that normally "machines dry." Adaptation of the unit to virtually any machine tool is simplified by use of an adjustable magnetic holder. Pressure required to create spray is obtained by linking the unit to the plant air-line system. Wesco Tool, Inc.



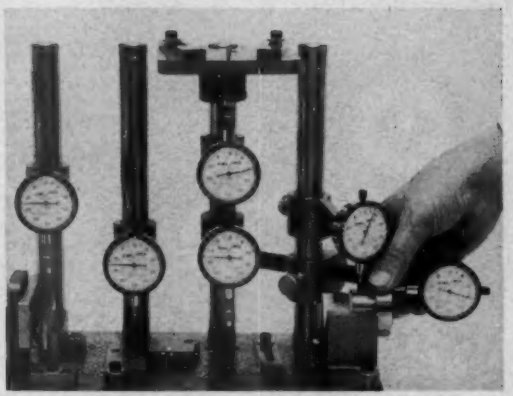
Drills, reamers and other cutting tools are clamped hydraulically in the chucking unit illustrated. Designed for either manual or automatic operation, the unit is actuated by turning a screw. Hydraulic fluid introduced under high pressure expands or compresses the chucking surface, creating a tight fit between chuck and tool. Scully-Jones and Co.



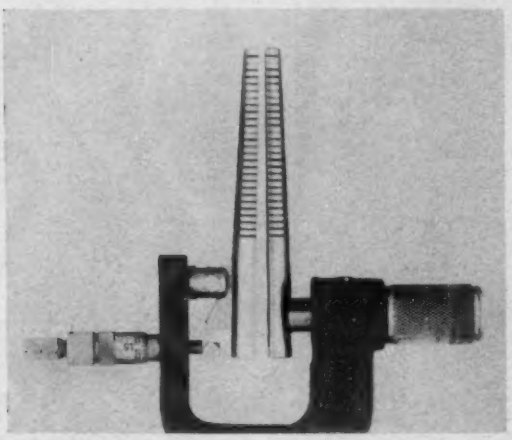
This powered feed table is designed for feeding machine heads or work fixtures in special machines. Dial-control feed rates are provided from ½ to 40 ipm on longitudinal and cross slides. A clutch permits hand positioning. Backlash is eliminated by nut adjustment. Master Mfg. Co., Inc.



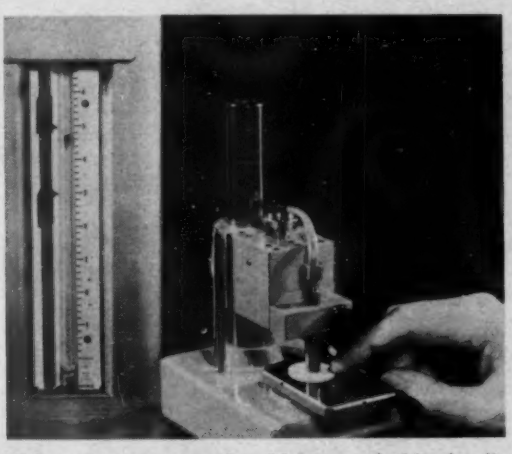
Direct reading measurements accurate to 0.0001 inch are attained in the micrometer illustrated. This model, the newest version of an accepted measuring instrument, combines the accuracies of light wave pressure and screw micrometers. Van Keuren Co.



This combination of indicator units can be set up to inspect as many as ten dimensions. When inspection of a greater number of dimensions is required, two or more of these fixtures can be adapted to one setup. Wm. L. Riggs Co.



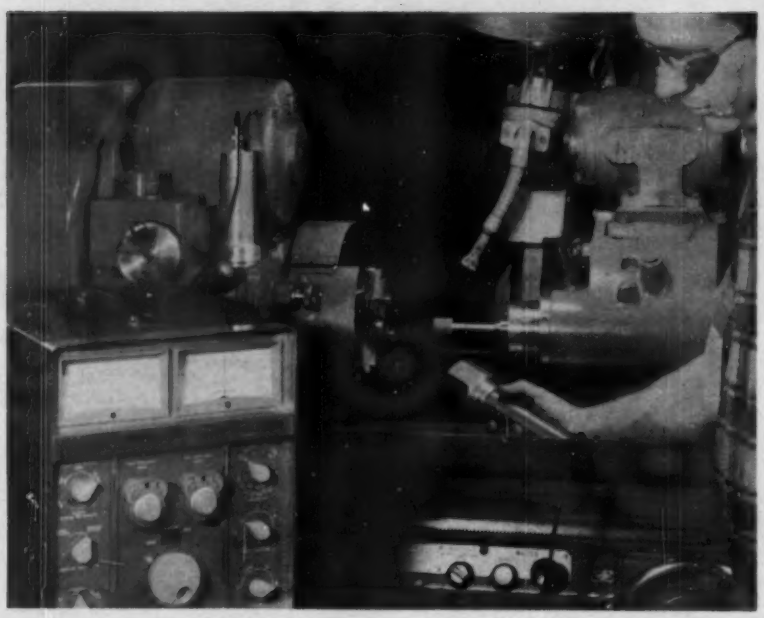
Designed to measure internal tapered parts, this micrometer eliminates errors of repeatability that occur when a part is removed from, and returned to, a machine. In use, this tool combines the principles of the sine bar and the conventional micrometer. Measurements read on the micrometer are equivalent to the gage-block readings obtained in sine-bar setups. Taper Micrometer Corp.



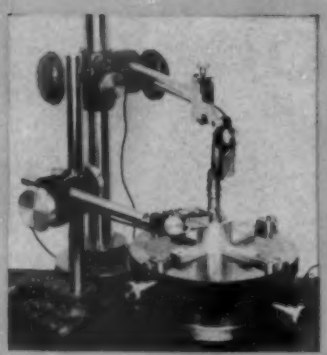
This gage measures the thickness of thin fragile parts such as germanium and silicon wafers by suspending them between opposed jets of air. Air flowing out of the jets calipers the parts and indicates thickness by actuating a float in a glass column. This method of inspection provides accurate measurement without subjecting the parts to possible damage from gage-point pressures. The Sheffield Corp.

This autocollimator measures around an X-Y axis to determine the angle of an obliquely tilted surface. In use, measurements are taken by readings from drums that are turned to align an external mirror with the workpiece. At distances up to 35 ft the autocollimator has a repeatability factor of ¼ sec of arc. At 135 ft repeatability is 2 sec. Davidson Optronics, Inc.

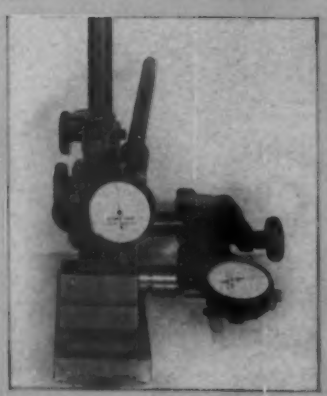
# measurement and inspection



Sources of vibration in machines, buildings and pipes are detected and studied with this vibration analyzer. The unit is shown monitoring the vibration pattern of an internal-external grinder. This is accomplished by reading deviations from normal (acceptable vibration) on frequency and amplitude scales. Stroboscopic flash—automatically set by the total signal at the sensing point—is utilized for visual detection of vibration sources. RayData Corp.

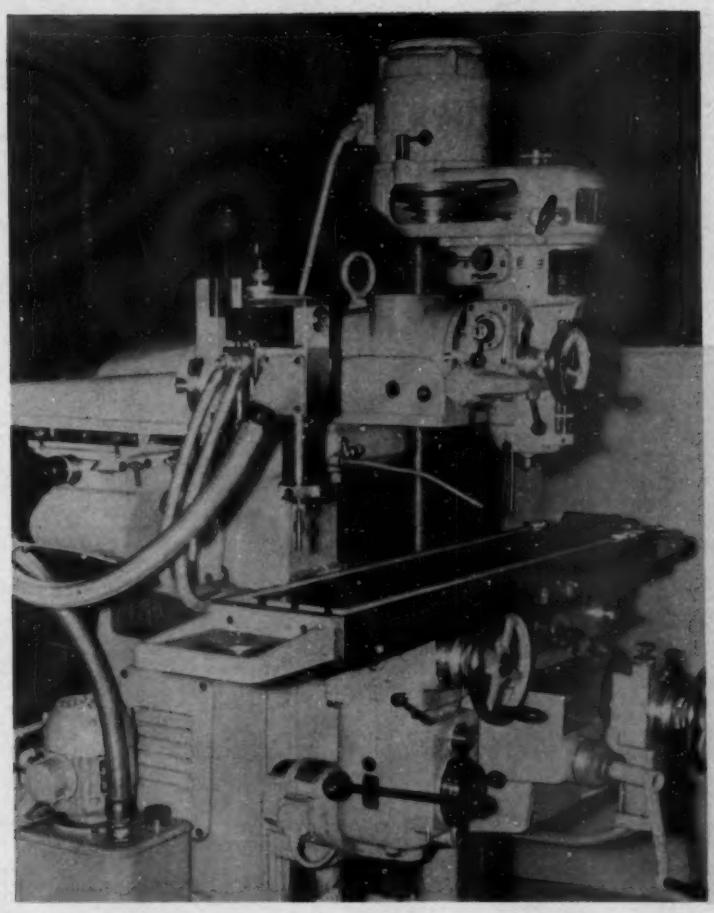


Squareness, roundness and concentricity can be checked to one-millionth of an inch in this turntable. In use, alignment of the workpiece to coincide with the axis of the turntable is effected with a wedge device. This permits fast setup for inspection to the sixth decimal place. Cleveland Instrument Co.

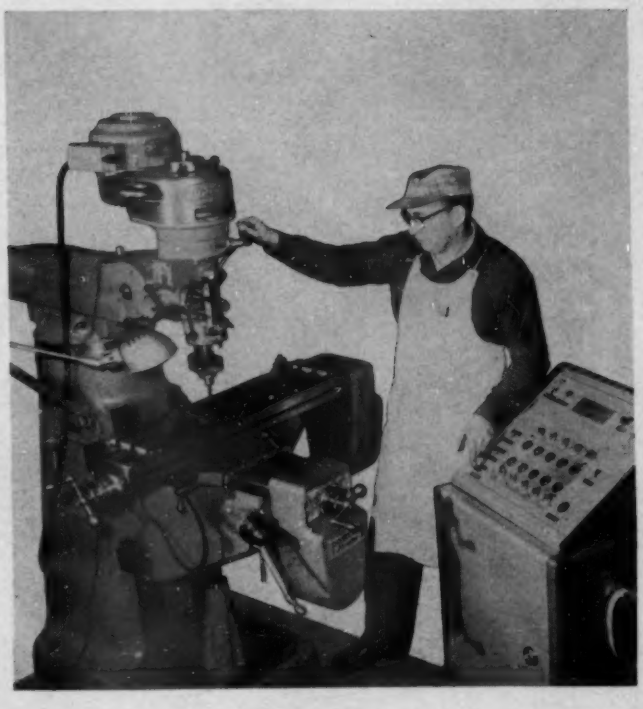


Designed for maximum versatility, the improved Dorsey indicator stand is adaptable to use as either a comparator or height gage. Three columns—one vertical and two horizontal — provide a greater range of applications than is normally found in tools of this type. As shown, the stand is adaptable to simultaneous inspection of two critical dimensions. Dorsey Gage Co., Inc.

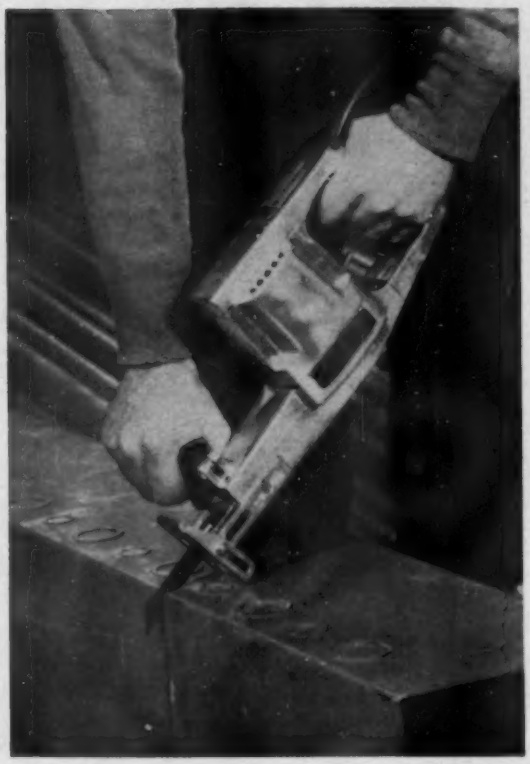
Small parts can be inspected quickly and accurately in this optical comparator. A variety of interchangeable lenses increases the unit's versatility and an attached toolmaker's microscope implements its accuracy at higher magnifications. Opto-Metric Tools, Inc.



Heavy-duty construction and ease of maneuverability are combined in this vertical milling machine. Six automatic feeds plus a sensitive hand-control unit are included in the head. The knee is a unified type that includes 24 automatic feeds plus a rapid traverse. Large longitudinal and crossfeed used in conjunction with a 12-inch head travel permits the machining of comparatively large work. Manex Machinery Corp.

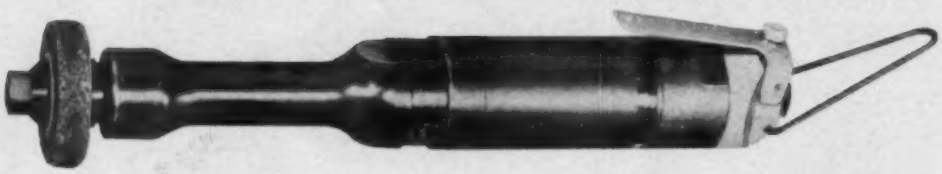


The numerical control unit shown at the right of the Bridgeport mill can be adapted to any vertical mill. Adaptation is accomplished by fitting the mill with a transducer assembly, position indicating controls and motor drives. The fully transistorized control console contains a digital converter, tape reader and motor controls. Programming is accomplished with a transistorized measuring machine that prepares tape for five-figure dimensions on two axes. Available, but not illustrated, is a block reader that reads a block of 128 holes, using 1-inch wide, 8-hole tape. Ultrasonic Precision Co.

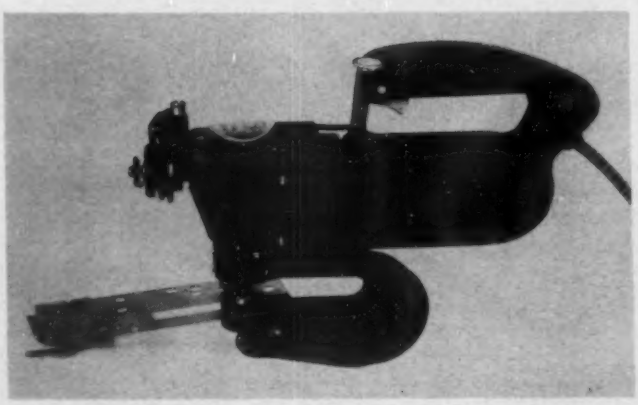


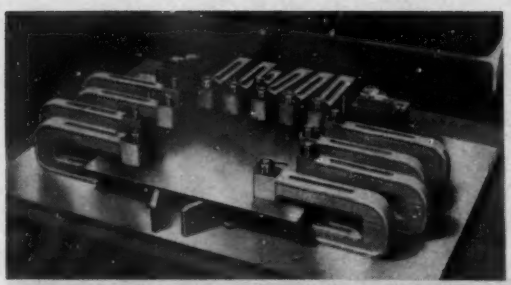
Two-speed operation makes the Stanley portable saw adaptable to an unusually large variety of cutting applications. These include the sawing of wood, plasterboard, plastic, pipe and steel. A squaring device enables the saw to cut flush in vertical or horizontal planes without the use of additional attachments. The Stanley Works.

The spindle of this pneumatic grinder is mounted on two widely spaced bearings as an aid to improved accuracy in alignment. Driven by a swastika type motor, its operating speeds range from 16,000 to 25,000 rpm. Because of its shape, this tool is ideally suited to recess grinding in diemaking applications. Thomas C. Wilson, Inc.

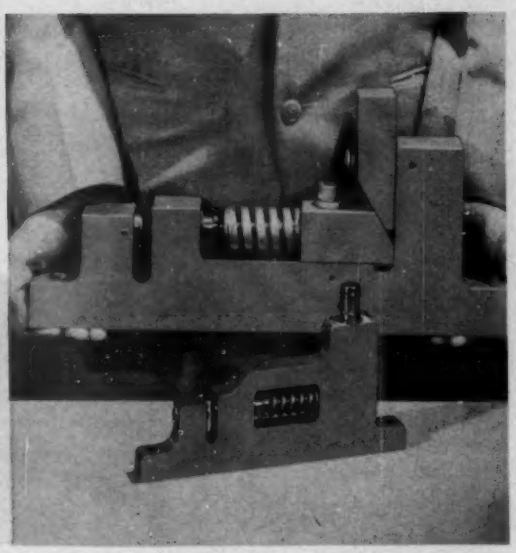


Designed to perform the work of a heavy-duty punch press, this tool can punch round, square, rectangular and irregular holes. Conversion from one hole shape to another is accomplished with interchangeable dies. This tool is especially valuable for piercing operations in applications where the use of a large press is economically or mechanically impractical. Modern Mfg. Co., Inc.

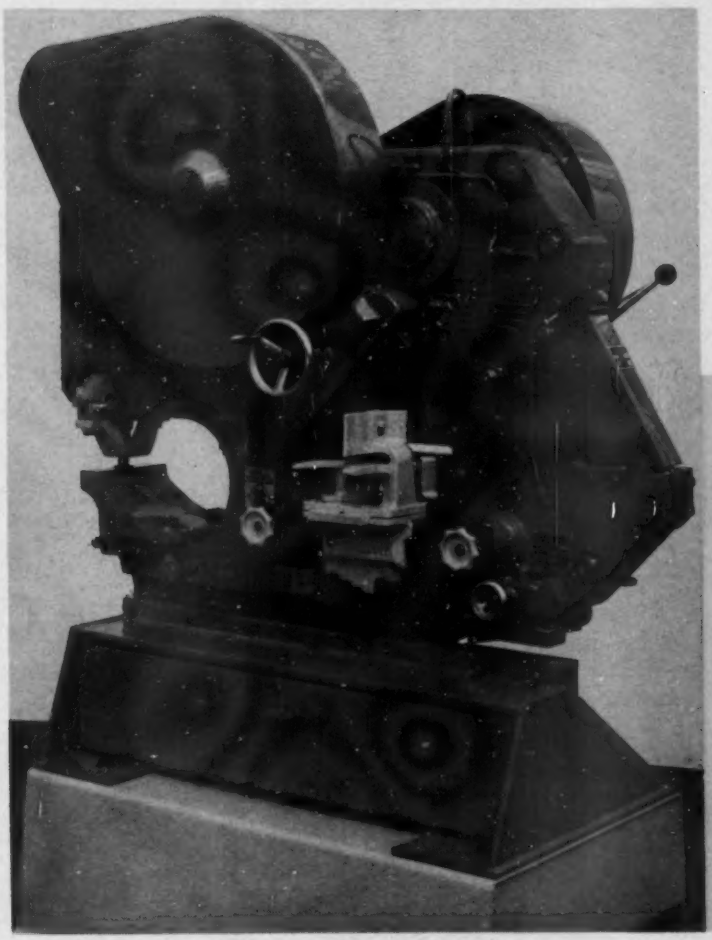




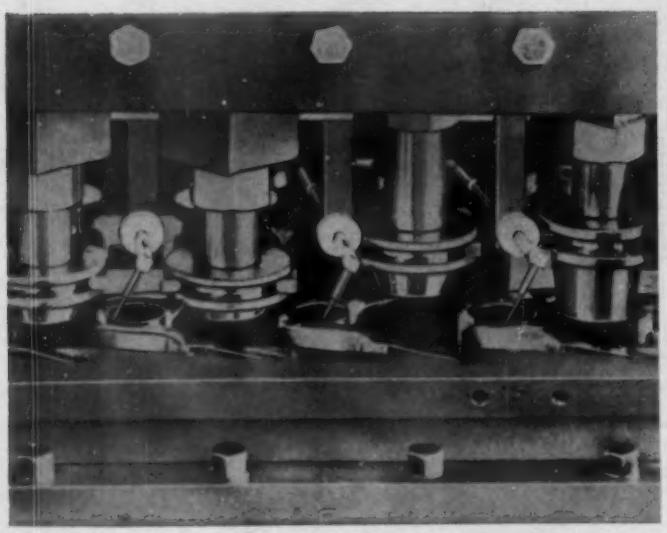
Designed to eliminate the expense of stamping dies for multiple piercing and notching operations, these units can easily be converted from one setup to another. Recent improvements in their design permit changeover of individual units by interchange of their punches and dies. Keyed punches and dies make the units adaptable to the piercing of holes with irregular contours. Wales Strippit, Inc.



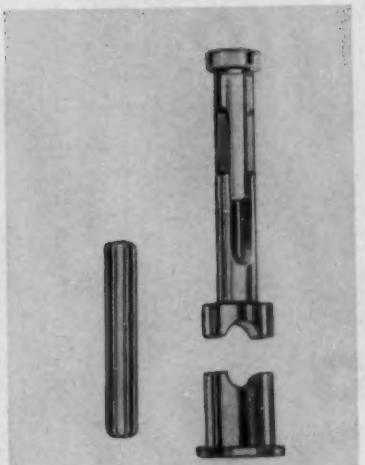
These cam-pierce units are designed to replace cam dies in flange-piercing operations. Because each unit contains its own driver no upper die or attachment to the press ram is required. Punch Products Corp.



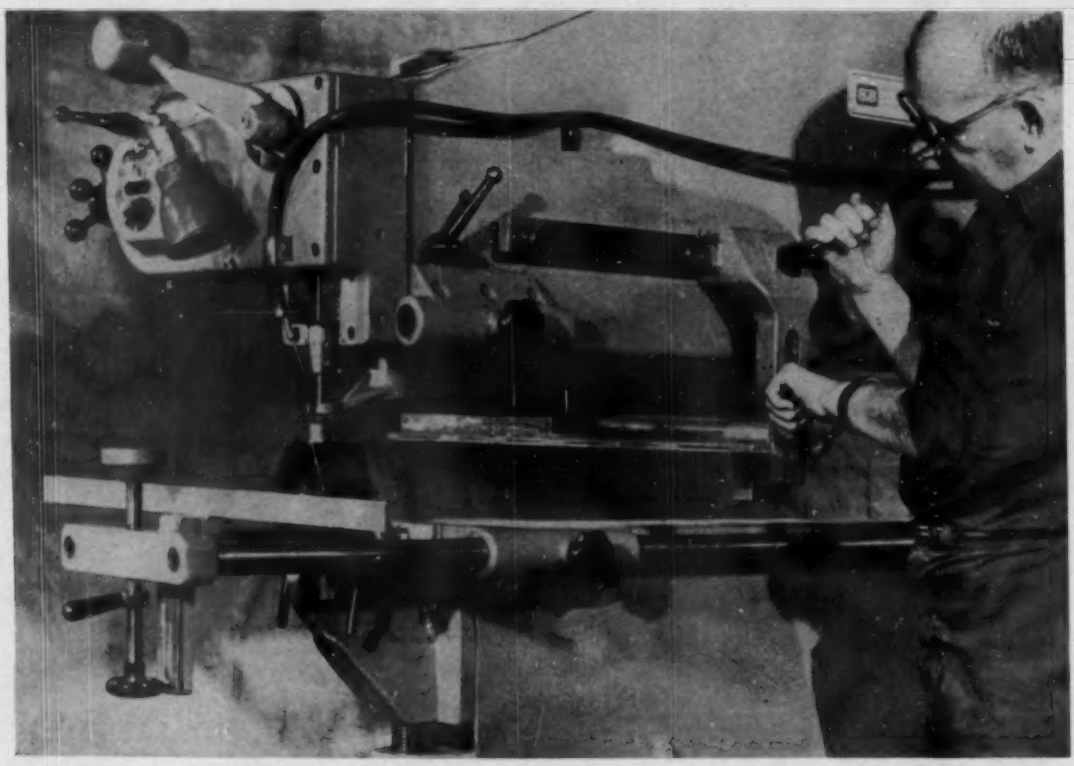
Built for fabricating tees, angles, squares and rounds, this machine minimizes tooling changes between two different jobs. This is accomplished by a universal die block—standard on all models—that entirely eliminates tooling changes at the punch. Additional economies are effected with a newly designed bevel-gage attachment that simplifies the cutting of angles and tees. Upton Bradeen & James, Inc.



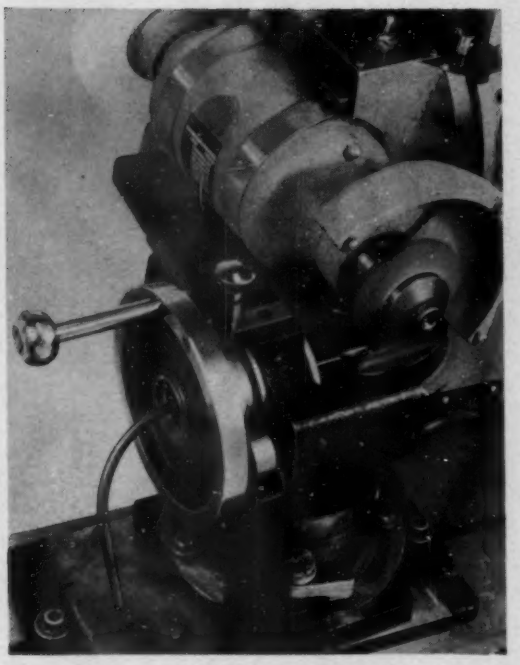
The safety device illustrated detects potential press overloads and stops slide movement before die closure. Principal use of the unit is in transfer-die applications. In operation, electronic feelers mounted on the punch detect double headers or errors of part progression and automatically stop the press. Wintriss Controls, Div. Industrionics Controls, Inc.



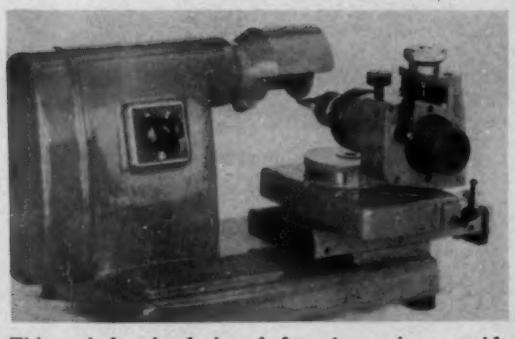
Small holes can be pierced in cylindrical parts with perforating punches of this design. In operation the workpiece is located and supported in opposed concave nests. Maximum punch support during piercing is provided by a sliding sleeve that interlocks with the retainer. Durable Punch & Die Co.



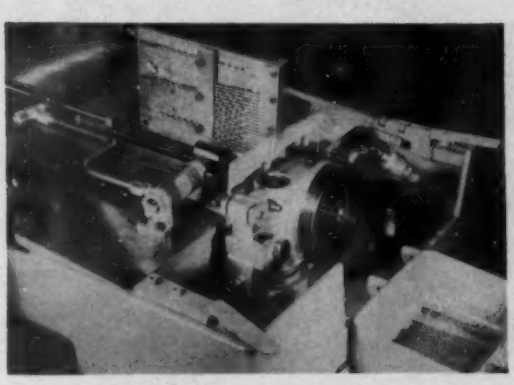
In addition to conventional nibbling and shearing operations, this machine performs flanging, beading, folding, peening and tube notching. Head operation is that of a conventional slide. An adjustable tooling area permits use of a wide variety of tools for other press operations. The Claremont Co., Inc.



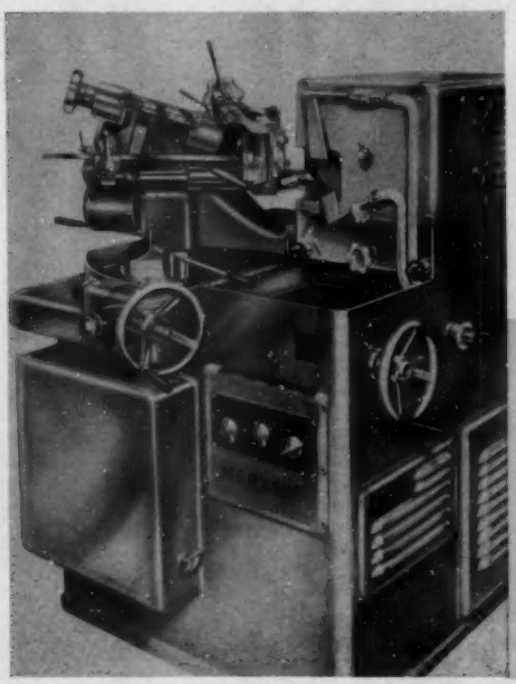
Designed for sharpening bent and hook shank taps, this fixture eliminates the necessity of removing nib type taps from their shanks for flute and chamfer grinding. Setup is made by inserting the tap through the collet from the rear. Manually operated, the fixture can be mounted on all conventional cutter grinders. R-O Mfg. Co.



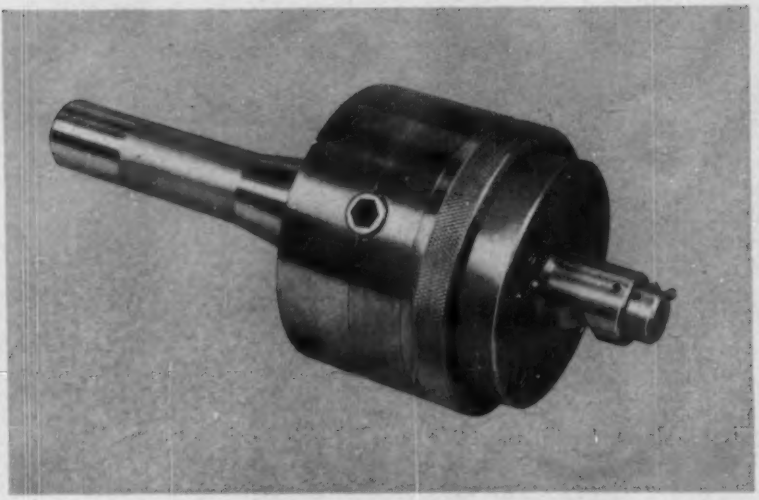
This grinder is designed for sharpening a wide variety of milling cutters. In use, the workpiece is positioned in the horizontal plane by an adjustable cross slide. Vertical positioning is obtained by a spindle and graduated nut that raise and lower the dividing head. Franz Kuh'mann KG



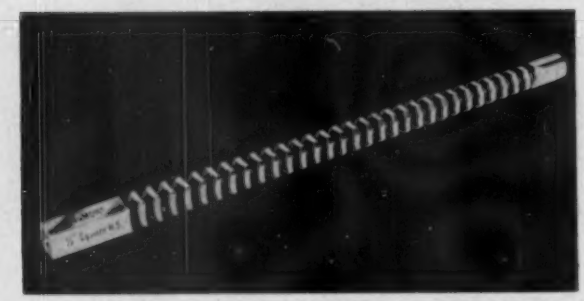
All operations—feeding, sharpening, wheel dressing and compensation—are automatic in the drill pointer illustrated. Designed for high production and precision, it can grind as many as 1500 drills per hour to concentricity tolerances of 0.0002 inch. Winslow Product Engineering Corp.

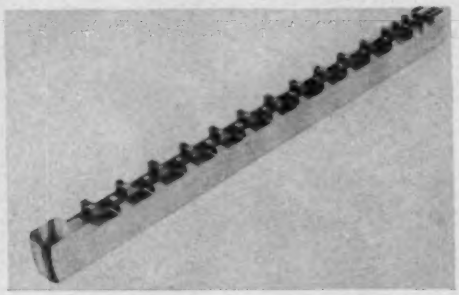


This drill grinder allows changes in drill chisel angles without increases or decreases in point clearance. Conversely, it also provides for changes in point clearance angles without changes in the chisel angles. Stock removal is controlled hydraulically and is adjustable between 0.005 and 0.250 inch. Mohawk Tools, Inc.

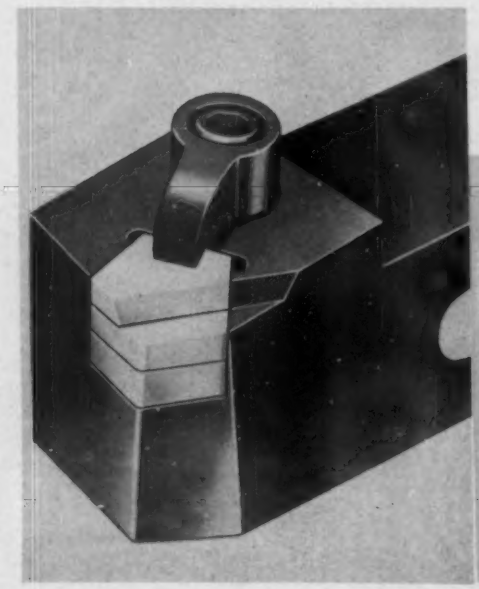


Remounting of boring tools to within several millionths of an inch of original settings is possible with this toolholder. These accuracies — attained by means of a special adapter fitted to the machine spindle — enable programmers to disregard tool-changing error in calculating tolerance factors. Wadell Equipment Co.

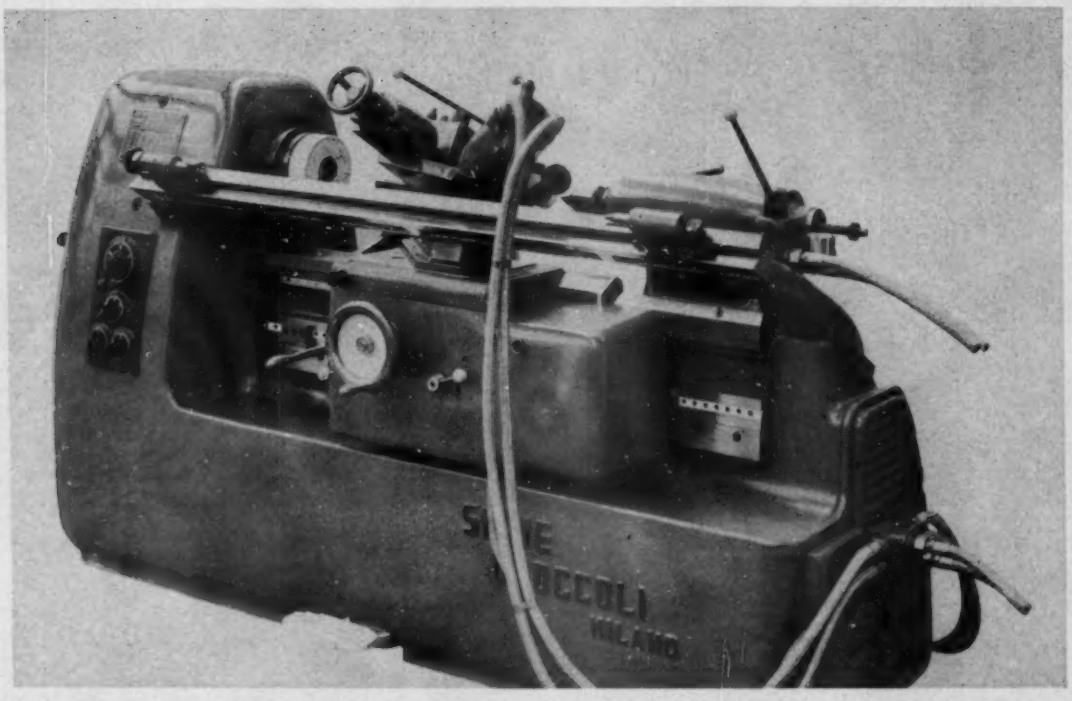




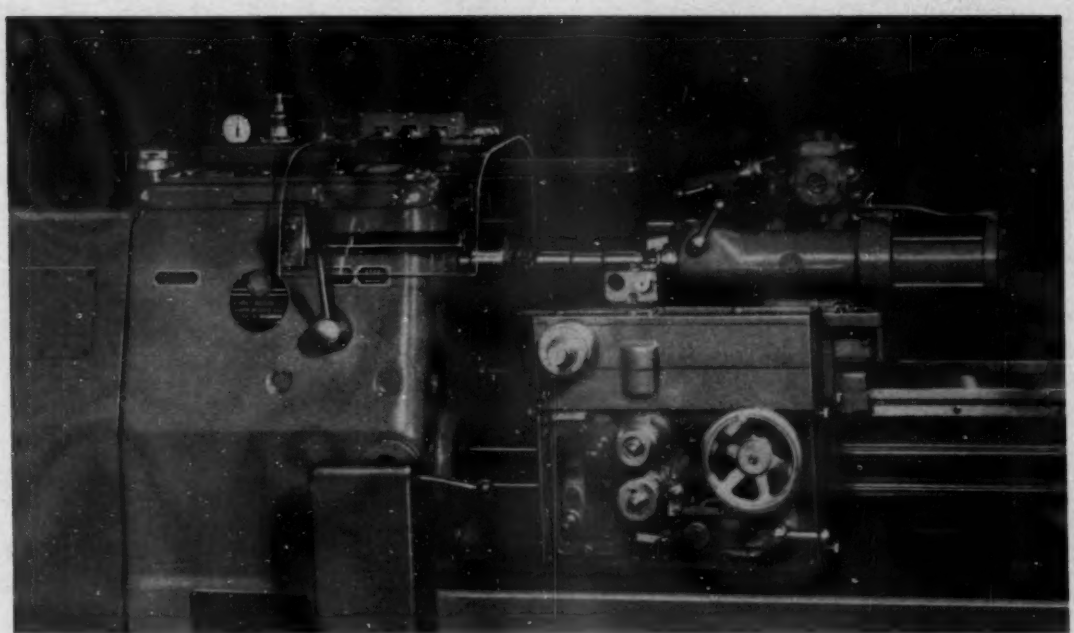
These broaches are designed for hole and keyway machining in an arbor press. Preliminary holes in the workpiece can be drilled, reamed or cast by conventional methods. duMont Corp.



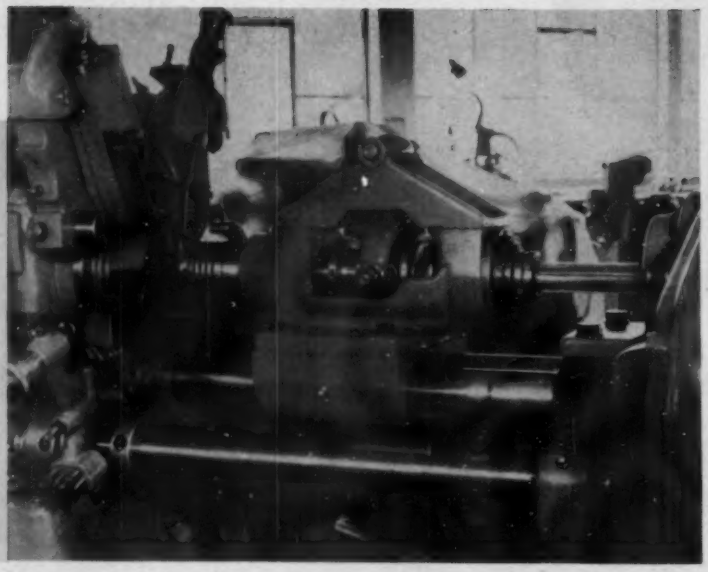
This negative rake tool is designed to hold the insert securely during machining and to provide a wide range of chipbreaker adjustment. Locking is accomplished with a cam pin that holds the insert against the back wall of the recess. Adjustment of rake angle is effected by turning a thumb wheel. Four indexable cutting points are provided by the diamond-shaped insert. Kennametal Inc.



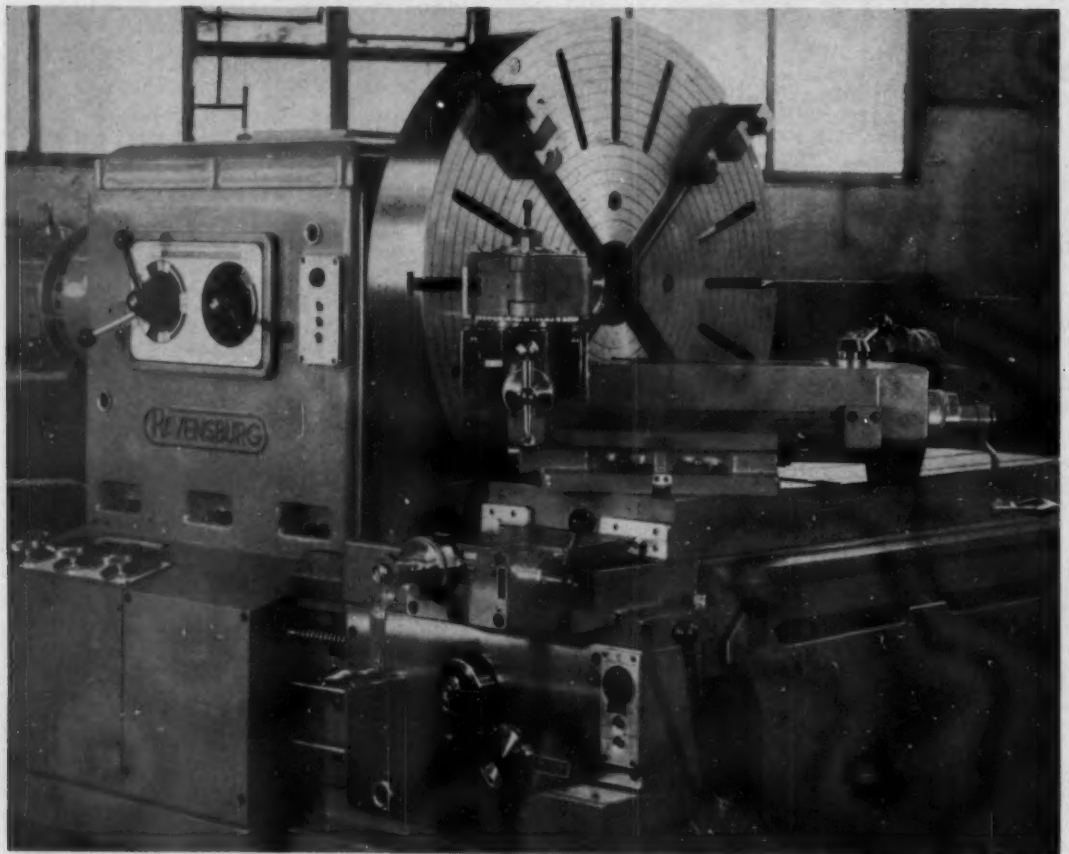
Either flat or round templates can be used for tracing operations in this lathe. Setup is effected by mounting the template between the centers visible at the front of the machine. In operation, all functions of the lathe are controlled hydraulically. Amitool Co., Inc.



Equipped with a tracing device, this automatic lathe produces highly accurate threads at speeds faster than is possible with thread grinding or milling. Single-point carbide tooling is used. In the application shown, the tracer unit has completed machining a shaft contour that is to be threaded. Threading is completed automatically in 20 passes. Gisholt Machine Co.



In this automatic screw machine opposed spindles are utilized to cut off parts without leaving a burr. Because the workpiece is driven from both ends, the parting tool is able to effect a clean cut without the breaking off that normally accompanies this operation. After the cut-off operation, the collet in the outside spindle releases the finished part. Traub, U. S. A., Inc.




Designed for facing large castings and weldments, this lathe is geared for the relatively low speeds and feeds required in these operations. When it is needed, a tailstock can be added for workpiece support by means of a sliding bed. Rudel Machinery Co., Inc.

# exhibitors

New York City
May 22–26

Visitors to the forthcoming exposition will be confronted with an impressive display of tools, machines and manufacturing equipment. Some of these products—lathes, shapers, drill presses—are refinements of conventional and long-familiar machines. Others, such as electrolytic and electrical-discharge machines, numerical control systems, etc., are comparatively new. Virtually all of the equipment exhibited is representative of the latest techniques in manufacturing and, as such, is symbolic of industry's drive toward super efficiency.

Because of limitations of space we have been able to present only a few of the products that will be exhibited at the Coliseum. Others of equal importance will be displayed by some 300 manufacturers. Names of exhibitors at the Coliseum—correct as of our press date—are listed in the following two pages.

## –A–

AA Gage Co.
ACF Electronics Div.
Aaron Machinery Co., Inc.
Accurate Bushing Co.
Aero Service Corp.
Aget Mfg. Co.
Airetool Mfg Co., The
Alameda Gage Co.
Allegheny Ludlum Steel Corp.
Aloris Tool Co., Inc.
American Drill Bushing Co.
American Machine & Foundry Co.
American Machinist/ Metalworking Manufacturing
American Metal Market
American Pullmax Co.
American SIP Corp.
American Twist Drill Subsidiary Brown and Sharpe Mfg. Co.
Ameurope Inc.
Amitool Co., Inc.
Andrews Tools & Machinery Co., Edward
Antares Instruments Inc.
Apex Machine Co.
Armstrong Bros. Tool Co.
Associated American Winding Machinery, Inc.
Austin Industrial Corp.
Automaticmill, Inc.
Avco Research and Advanced Development Div.
Avildsen Tools and Machines, Inc.

## –B–

Bachman Co., Inc., Eric R.
Balcrank Inc.
Barer Engineering & Machinery Co., Ltd.
Beaver Pipe Tools, Inc.
Bellows Valvair Corp.
Beloit Tool Corp.
Bendix Corp., The
Bentley Industrial Corp.
Boeing Applied Computing Services
Boggis Co., Henry P.
Boyar-Schultz Corp.
Bridgeport Machines Inc.
Bristol Co., The
Brown & Sharpe Co.
Buck Tool Co.

## –C–

Canton Chemical Corp.
Carr Lane Mfg. Co.
Cavitron Equipment Corp.
Cawi Machine Co.
Cazeneuve Lathes
Cerro Sales Corp.
Challenge Machinery Co., The
Charmilles Engineering Works, Ltd.
Cincinnati Milling Machine Co., The Meta-Dynamic Div.
Cincinnati Sub-Zero Products
Claremont Co., Inc., The
Clark, Cutler & McDermott Co.
Clausing Div., Atlas Press Co.
Clearing Div., U.S. Industries
Clementina Ltd.
Cleveland Instrument Co.
Coil Winding Equipment Co.
Collier, Inc., P. F.
Collins Microflat Co.
Columbia International Corp.
Commander Mfg. Co.
Consolidated Kinetics Corp.
Cooper Weymouth, Inc.
Crafts Co., Inc., Arthur A.
Craley Mfg. Co., C. C.
Crodian & Co.
Crucible Steel Co. of America
Crystal Lake Machine Works, Inc.
Custanite Corp., The

## –D–

Davey Compressor Co.
Davidson Optronics, Inc.
Dayton Perforators, Inc.
Dechert Dynamics Corp. Zeh & Hahnemann Press Div.
Detroit Stamping Co.
Devcon Corp.
DeVlieg Microbore Div. DeVlieg Machine Co.
Di-Acro Corp.
Diamond Tool Research Co., Inc.
Die Draulic Grip, Inc.
Diehl Mfg. Co.
DoAll Co., The
Doeden Tool Corp.
Dorsey Gage Co.
Dow Mechanical Corp., The
duMont Corp., The
Dumore Co., The
Dunham Tool Co., Inc.
Durant Tool Co.

## –E–

Easco Products, Inc.
Eastern Machine & Tool Co.
Edgcomb Engineering & Engraving Co.
Enco Mfg. Co.
Encyclopaedia Britannica
Engelhard Hanovia, Inc. Industrial Diamond Div. National Electric Instrument Div.

Engineering Societies Library
Erico Products, Inc.
Ettco Tool & Machine Co., Inc.

## – F –

Fairchild Publications, Inc.
Farrand Controls, Inc.
Fenlind Engineering Co.
Fenway Machine Co., Inc.
Ferguson Machine Corp.
Flick Reedy Corp.
Frick-Gallagher Corp.
Friden, Inc.

## – G –

Gaertner Scientific Corp., The
Gammons-Hoaglund Co.
General Automation Corp.
General Electric Co.
General Industrial Diamond Co.
Gisholt Machine Co.
Gleason Works
Green Instrument Co.
Grobet File Co. of America, Inc.
Gulf Oil Corp.
Gurley, W. & L. E.

## – H –

Hamilton Watch Co.
Hammond Machinery Builders, Inc.
Harig Mfg. Corp.
Harnischfeger Corp.
Harrison Lathe Div.
Heinrich Tools Inc.
Heller Tool Co.
Hermes Machine Tool Co., Inc.
Hevi-Duty Electric Co.
Hillyer Corp.
Hitchcock Publishing Co.
Homestrand Machine Tool Corp.
Howard International Corp
Hudson Automatic Machine & Tool Co.
Hughes Industrial Systems Div.
Huron Machine Products, Inc.
Hy-Du-Lignum Co., Inc., The

## – I - J - K –

Indi-Square Co., Inc., The
Industrial Machines and Services, Inc.
International Business Machines Corp.
Industrial Research
J & S Tool Co., Inc.
Jarvis Corp.—Carbide Subsidiary
Jarvis Corp.—Machine Tools & Attachments Subsidiary
Jiffy Disintegrators, Inc.
Jiffy Mfg. Co.
Kennametal Inc.
Klingelhofer Machine Tool Corp., Albert
Krieg, Inc., Victor J.

## – L –

L & R Mfg. Co.
Lapointe Machine Tool Co., The
Lassy Tool Co.
Laurel Corp., The
Lepel High Frequency Labs., Inc.
Livernois Engineering Co.
Lixie, Inc.
Logan Engineering Co.
Logansport Machine Co., Inc.
Lufkin Rule Co., The

## – M –

M.B.I. Export & Import Ltd.
M & M Tool & Mfg. Co.
Machinery (The Industrial Press)
Mac Rae's Blue Book
Mahr Gage Co.
Malcus Tools Corp.
Manex Machinery Corp.
Marac Machinery Corp.
Martin Engineering Co.
Master Chemical Corp.
Master Mfg. Co.
Mercuria Co.
Merrill Brothers
Metal Removal Co., The
Metallurgical Products Div., G.E.
Metalworking Publishing Co.
Mettler Instruments Corp.
Micro Balancing Inc.
Micrometrical Mfg. Co. Miller Fluid Power Div.
Minnesota Mining and Mfg. Co.
Mitsui & Co., Ltd.
Mitutoyo Mfg. Co., Ltd.
Mobil Oil Co.
Modern Machine Shop
Modern Mfg. Co.
Mohawk Tools, Inc.
Montgomery & Co., Inc.
Moog Servocontrols, Inc.
Morris Co., The Robert E.
Muskegon Tool Industries, Inc.

## – N –

Nelco Tool Co., Inc. Subs. Brown & Sharpe Mfg. Co.
New Hermes Engraving Machine Corp.
Niemi Mfg. Co. Inc.
Nikon, Inc.
Nissho American Corp., The
Noble & Westbrook Mfg. Co., The
North American-Viking Drill Co.
Northwestern Tools, Inc.

## – O –

Oakite Products, Inc.
Oberg Mfg. Co., Inc.
Opto-Metric Tools, Inc.
Orban Co., Inc., Kurt
Osborn Mfg. Co., The
Ottavino Co., A.

## – P - Q –

Parker-Kalon Co.
Pedrick Machine Co.
Perkins Machine Co.
PIC Design Corp.
Pines Engineering Co. Inc.
Portage Double Quick, Inc.
Porter Precision Products
Pratt & Whitney Co., Inc.
Precision Carbide Corp.
Precision Detroit Co.
Precision Welder & Flexopress Corp.
Procunier Safety Chuck Co.
Producto Machine Co., The
Progressive Welder & Machine Co. Frostrode Div.
Punch Products Corp.
Quality Control Corp.

## – R –

R. B. Tool Co.
R. O. Mfg. Co.
RayData Corp.
Rem Sales Div.
Ren Plastics, Inc.
Rheem Mfg. Co.
Richards Co., J. A.
Riggs Co., William L.
Rowe Machinery & Mfg. Co., Inc.
Rudel Machinery Co.

## – S –

S & S Machinery Co.
Man-Au-Cycle Corp. of America
Sandvik Steel, Inc.
Sanford Mfg. Corp.
Scherr-Tumico Co.
Schrader's Son, A. Div., Scovill Mfg. Co., Inc.
Scully-Jones and Co.
Segal, Edward
Seibert & Sons, Inc.
Sentry Co., The
Service Machine Co.
Sheffield Corp., The
Sheldon Machine Co., Inc.
Siewek Tool Co.
Sifco Metachemical Co.
Sigma Machinery Inc.
Simonds Abrasive Co.
Simonds Saw and Steel Co.
Simplicity Engineering Co.
Simpson Optical Mfg. Co.
Sintercast Div. of Chromalloy Corp.
Skilcraft Corp.
South Bend Lathe, Inc.
Spitfire Tool and Machine Co.
Standard Pressed Steel Co.
Standard Tool & Mfg. Co.
Stanley Electric Works Div. The Stanley Works
Starlite Industries
Starrett Co., The L. S.
Steco Corp., The
Stewart-Warner Corp.
Sun Oil Co.
Sunnen Products Co.
Superior Die Set Corp.
Supreme Products Corp.
Swanson-Erie Corp.
Sylvania Lighting Products

## – T –

Taper Micrometer Corp.
Templet Industries Inc.
Texaco Inc.
Thompson Ramo Wooldridge, Inc. Dage Div.
Torit Mfg. Co.
Torrington Co., The
Traub, Inc.
Triplex Machine Tool Corp.
True Steel Div.

## – U –

U. S. Dept. of Commerce
U. S. Tool Co., Inc.
Uddeholm Company of America
Ultramatic Equipment Co., Inc.
Ultra Sonic Precision Co.
United Associates
United States Leasing Corp.
Upton Bradeen & James, Inc.

## – V –

VDF Lathe Div. Rudel Machinery
Van Keuren Co., The
Vernon Devices, Inc.
Vidmar, Inc.
Visual Inspection Products
Vlier Engineering Co.
Vulcan Tool Co.

## – W - Z –

Waddell Equipment Co.
Wales Strippit, Inc.
Walker Co., Inc., O. S.
Watts Regulator Co.
Waukesha Cutting Tools, Inc.
Wesco Tool Co., Inc.
Wespo Div. Vlier Engineering Co.
Wheelabrator Corp.
Whistler & Sons, Inc. S. B.
Wilson Co., Thomas C.
Wilton Tool Mfg. Co., Inc.
Winslow Product Engineering Corp.
Wintriss, Inc.
Zero-Max Co., The

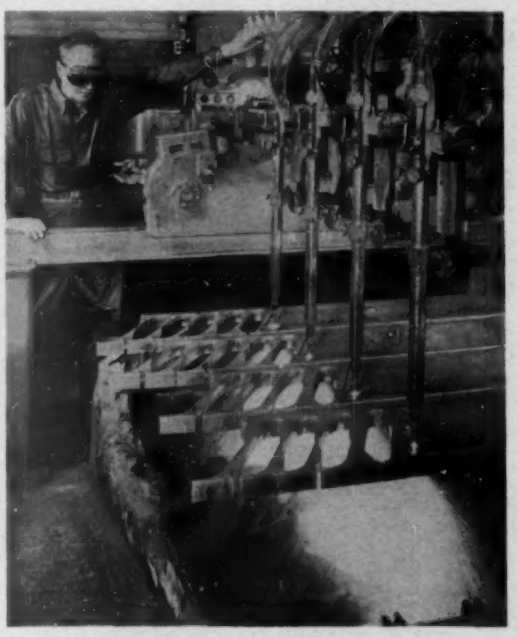
# Speaking of PRODUCTIVITY...

PROBABLY the most comprehensive review of new manufacturing developments ever presented—that's what industry sources are calling the technical sessions of the ASTME Engineering Conference. Add to the technical sessions a two-day Surface Metrology Seminar, a symposium on material removal progress, nine plant tours and three Techtours—combined technical sessions and plant tours where new manufacturing developments are studied firsthand—and you have the year's best opportunity to take a short, but thorough, postgraduate course in creative manufacturing.

More than 50 speakers, each an expert in some phase of modern metalworking, will be on hand to discuss new techniques, new processes, new concepts of manufacturing. The scope of the program is indicated by the titles of some of the individual sessions—operations research, automation and numerical control, powder metallurgy, workholding developments, grinding, press tooling progress, cutting tool materials, to name a few. Emphasis will be on practical applications—information that participants will be able to take home and put to work in their own plants—but most speakers will also cover the scientific and engineering background of the new developments they describe—information that is important to the understanding and intelligent application of these new developments.

### Outlook on Numerical Control

Speakers at the technical sessions believe that numerical control has reached the stage where it can be profitably applied in just about any plant. However, S. M. Matsa, IBM senior analyst, points out that producing the control tapes for milling three dimensional parts can be expensive and time-consuming without the use of a computer. Consequently, computer programs have been developed to automatically generate machine instructions. To date, most computer programs have been limited to two dimensions. Matsa's paper, "A Generalized Automatic Programming System for Three Dimensional Machining with Numerical Control," covers



**AMERICAN MACHINE & FOUNDRY CO., Brooklyn, N. Y.—These automatic tracing flame cutting machines are among the 1200 machine tools that visitors will see during the ASTME tour of American Machine & Foundry's Brooklyn facility on May 24. By automatically tracing a line drawing, the machines can duplicate a variety of shapes from sheet or plate.**

**ADAMAS CARBIDE CORP., Kenilworth, N. J.— Finishes on carbide surfaces are being checked with a profilometer and a Rockwell hardness tester at Adamas' quality control laboratory. Other operations that will be seen during the ASTME tour of the plant on May 23 are the forming of presintered carbide with silicon carbide wheels, the automatic stoker sintering of carbide at 1500 C and the pressing of carbide bushings at 15 tons per square inch.**

a highly significant development—a three-dimensional system for describing and machining complex shapes. The part programmer, working from a blueprint, specifies each of the constituent surfaces of a part (portions of planes, ellipsoids, spheres, cylinders and so on) and how they are combined into "regions." The computer takes up the work from there, translating the part definitions, determining all the required curves of tool travel and, finally, generating the appropriate machine instructions. With this system, programming time is shortened, consequently lead time is shortened—an important factor in today's rapidly advancing technology.

Reliability is one of the key words in manufacturing. Regardless of the amount of planning and the efficiency of machining techniques, if machine tools are idle due to poor design or inadequate maintenance procedures, a company can lose a large part of a considerable investment. This is particularly true of numerically controlled machine tools. Because of their high productivity, a few hours of downtime can mean a large loss in output. In his paper, "Planning a Maintenance Program for Numerically Controlled Equipment," J. J. Childs, chairman of Republic Aviation Corp.'s numerical control program, describes reliability features to be considered when selecting numerically controlled equipment and covers the maintenance experience gained during three years' operation of numerically controlled machines at Republic Aviation.

Can existing machines be "retrofitted" (converted) for numerically controlled operation? This is one of the key questions asked by companies that are considering numerical control. The answer given by William B. Johnson, Rocketdyne industrial engineer, is a qualified "yes." His talk covers the engineering problems involved in taking an existing—worn-out—precision boring machine, rebuilding it, and fitting it for numerical control. The completed machine will be used as a precise measuring inspection machine as well as for boring and

**LYCOMING DIV., AVCO CORP., Stratford, Conn.— A highlight of the Lycoming tour during the Society's Engineering Conference, this system enables the operator to see the weld as it forms, by means of magnification on a closed circuit television receiver. Lycoming uses the system for "inside-out" welding of the sections of rocket chambers. Also on the tour agenda is a look at the plant's two lines of gas turbine engines as well as a visit to the missile systems department, where re-entry vehicles for the Titan, Atlas and Minuteman intercontinental ballistic missiles are produced and assembled.**

milling—a strong indication that when suitably rebuilt and modified, existing machines, even old ones, can be successfully retrofitted for numerical control.

Numerically controlled contouring machines can develop excessive acceleration and deceleration forces when commands are given as step functions. Traditionally, this limitation has been circumvented by either reducing the maximum velocity of the system to that possible in one step or by using many steps of velocity to allow the machine tool to operate within its safe limits. In a talk on the "Automatic Internal Override of Feed Rate in Numerically Controlled Contouring Machine Tool Systems," James K. Livingstone and Richard P. Bloss describe "infro," an automatic device that limits the acceleration and deceleration forces to those safe for the machine tool.

Numerical control is not limited to complex milling and boring operations. R. E. McKee of the R. K. LeBlond Machine Tool Co., covers lathe operations in his talk, "Continuous Path Turning on Numerically Controlled Lathes." The lathe he describes performs the same type of work as conventional tracer lathes. Joseph L. Burg of Burg Tool Mfg. Co., Inc., shows how numerical control is being applied to turret type drilling machines in his paper, which is entitled "Numerically Controlled Turret Drilling."

### Advances in Metalcutting Science

Several advanced new machining processes will be covered at the ASTME Engineering Conference. Speaking on the "Electron Beam Process for Super Alloys," H. A. James will describe this exotic new process, in which a beam of high-energy electrons is used to cut even the hardest materials to extremely close tolerances. An equally interesting advance, this time in basic metalcutting research, is covered in Max Kronenberg's talk, "Ultrahigh-Speed and Other Metalcutting Phenomena Explored by Dimensional Analysis." Dimensional analysis, a new method of studying metalcutting phenomena, has long been used to explain phenomena encountered in the design of hydraulic systems and the air-flow patterns in supersonic aircraft. Applying dimensional analysis to metalcutting, Dr. Kronenberg shows why cutting tools do not break down at cutting speeds of over 100,000 fpm and how new insights into machining can be obtained mathematically, without extensive testing.

Vibratory finishing, in which a mixture of parts and abrasive is agitated to remove burrs and impart high surface finishes is described by R. D. Taylor, Lord Chemical and Equipment Div. of Wheelabrator Corp. The advantage of this finishing process is that it is much faster than conventional tumbling or barrel finishing. An added advantage—the vibratory action forces abrasive through holes and other protected areas which formerly had to be finished by hand. Taylor's talk is entitled "New Techniques of Metal-Removal Through Vibratory Finishing and Deburring."

**FORD MOTOR CO., Mahwah, N. J.—Mahwah, which in Indian means "meeting place," will indeed live up to its name when Society conventioners congregate there on May 23 for a tour of the Ford assembly plant. While viewing the complete construction of an automobile, the ASTME group will see the flame-welding operation shown here, as well as a gigantic press welding machine that simultaneously welds 140 separate points of the auto body floor pan. At the 40-acre plant, both car and truck components are assembled and brought together on a 10-mile network of conveyors.**

The big news in the cutting tool field is still the successful application of ceramics. D. R. Kibbey and H. D. Moore, both of the Ohio State University, show how ceramic tools can be rapidly tested. Their talk, "Evaluation of Ceramic Tools," describes a testing method in which severe cutting conditions are established. The results, correlated with the results obtained when tools are subjected to normal cutting conditions, are useful in predicting tool life.

Carbide cutting tools—particularly the newer varieties—are the workhorses of modern machining. James M. Galimberti, project engineer at Kennametal Inc., shows how improved carbides, notably the titanium carbides, are capable of outproducing conventional carbides by a wide margin on many jobs. This paper is called "Recent Developments in Metal-cutting Carbides."

Much valuable machining data is contained in Hans J. Heine's talk, "New Horizons in Machining of Malleable Iron Components." He describes the

**REPUBLIC AVIATION CORP., Farmingdale, N. Y.—Engineers visiting Republic's plant during the ASTME Engineering Conference will see this huge Giddings and Lewis milling machine in action. Numerically controlled, the machine is used to produce complex three-dimensional aircraft parts. The tour is part of the Techtour, "Manufacturing with Numerical Control Systems," on Wednesday, May 24. Other features of the one-day program will be talks by Republic's J. J. Childs, IBM's S. M. Matsa and North American's W. B. Johnson. Besides a variety of tape-controlled machines, Techtour registrants will see the final assembly of an advanced fighter-bomber.**

results of an investigation of the use of ceramic tools for making interrupted cuts on several grades of ferritic and pearlitic malleable iron. Relationships between tool life, cutting speed, feed, cutting fluid and depth of cut are covered.

The talk, "Effects of Constituents and Casting Technique on Cast-Iron Machinability," by Allis-Chalmers engineers Dimitri Kececioglu and George M. Tomko, goes far beyond a discussion of the machining operation itself. Investigating the machinability of seven different grades of gray iron, the authors show the influence of composition and casting practice on machinability. The results, expressed in terms of cubic inches of metal-removal per minute, give a good guide for determining optimum feeds and speeds when cutting various grades of gray iron.

### Latest in Grinding Developments

The advent of a grinding machine that can work to tolerances of $\pm 0.000010$ inch is described in Harold S. Sizer's talk, "Those Elusive Millionths." Sizer, director of design at Brown & Sharpe's Machine Tool Division, shows how a new concept of machine design makes it feasible to hold these tight tolerances in production.

Carle W. Highberg, industrial engineer for the Industrial Diamond Div. of Engelhard Hanovia, Inc., takes "A New and Realistic Look at Grinding Wheel Evaluation Procedures." He discusses new developments in synthetic and natural diamonds, then shows how existing testing and evaluation procedures are unsatisfactory because they cannot be realistically correlated with field usage. A new evaluation procedure for the diamond wheels used to face cemented carbides is covered in the talk.

### Manufacturing Management by Computer

In addition to being an important tool for engineers who are working with numerical control, computers can help management make major decisions quickly, according to C. J. Walker, IBM Corp. His talk, "The Inventory Management Simulator," describes the use of a computer to study the likely effects of an inventory management system before it is installed. How does computer simulation work? Briefly, computer routines are set up that represent various business situations. By varying computer subroutines, the effects of changes in inventory size, orders and so on can be evaluated. Many months of operation can be simulated on the computer in a few minutes. Results of the computer simulation are used in firm management planning.

Companies whose sales volumes lie below mass-production levels but above research and development quantities, face a complex problem with respect to predicting work loads for parts fabrication shops. Effective and economical operation can be realized when an optimum balance is found between labor costs and machine investment. A. P. Kromer and his associates at Ampex Professional Products Co. have studied problems of this type. Kromer reports their findings in his talk, "A Practical System of Calculating Work Loads and Predicting Manpower Requirements for Small-Lot Production Shops." A computer is used in the system he describes. The computer and punched cards handle all clerical operations, leaving only judgment decisions for planning personnel.

Operations research—a mathematical planning method—is an effective tool for decision making, according to Nicholas J. Radell, of Touche, Ross, Bailey & Smart. After discussing operations research techniques and theories, Radell gives a particular example in the field of inventory management and demonstrates the logic of an underlying mathematical equation. His talk is entitled "Concepts and Organization of Operations Research in Manufacturing."

The application of operations research to manufacturing is also covered by Gerald J. Demirjian of Touche, Ross, Bailey & Smart. He reviews the use

of operations research in determining the need for new manufacturing equipment and supporting facilities by presenting an actual case study.

### New Methods of Forming

Perhaps no subject covered by the speakers at the ASTME Engineering Conference will create more interest than explosive forming. In a paper, "Explosive Forming at Grumman Aircraft," Arthur Wickesser, Jr. and Arthur R. Garmendia, engineers who have put this new forming method to work, show how ideal blank dimensions are determined, how energy requirements are calculated and how charge size, shape and position are fixed.

Vasil Philipchuk points out in his paper, "Welding, Forging and Cutting Metals with Explosives," that almost any metal or alloy can be fabricated with explosives. In explosive welding, high pressures —therefore high temperatures—are created at the interface of the parts being joined. These temperatures are high enough to fuse the surfaces. In forging, a blank is driven into a die by explosive forces. Cutting with explosives is done with shaped charges that give a "jet action."

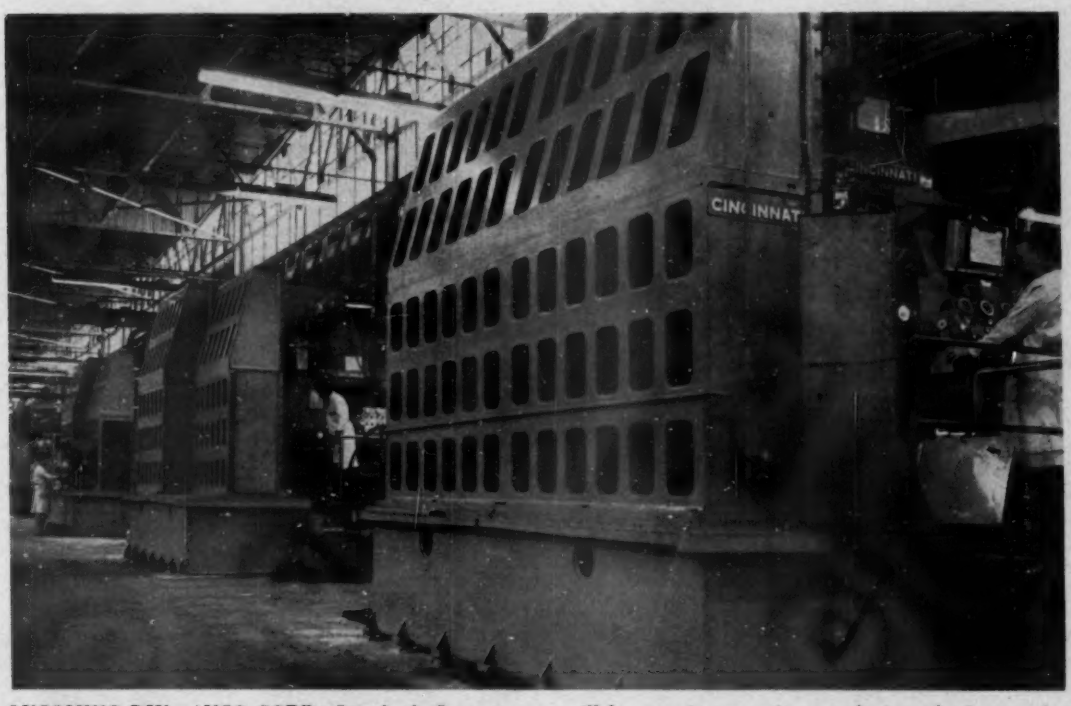
An Aerojet engineer, Guy C. Throner, shows how formed and sized components for large rocket engines are formed explosively. He also mentions the successful development of explosive methods for compacting powdered metals and ceramics. In his talk, "Forming, Forging and Compaction of Space-Age Metals by Controlled Explosion," he predicts that explosive forming will soon be commonplace.

## If You Can't Attend . . .

One of the major benefits to be derived from attending the Engineering Conference is the opportunity to ask questions of the speakers. For those who are unable to attend, however, ASTME is making available individual copies of the papers and complete sets of all papers available at a nominal price. The price for individual papers is 50 cents each to ASTME members, $1 each to nonmembers. Complete sets are available at $5 to ASTME members, $10 to nonmembers. Papers can be ordered by number by writing to the American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave., Detroit 38, Mich.

### Milestone in Measurement Science

Speakers at the two-day Surface Metrology Seminar will discuss all aspects of measurement science. Erwin G. Loewen's paper, "Controlling Surface



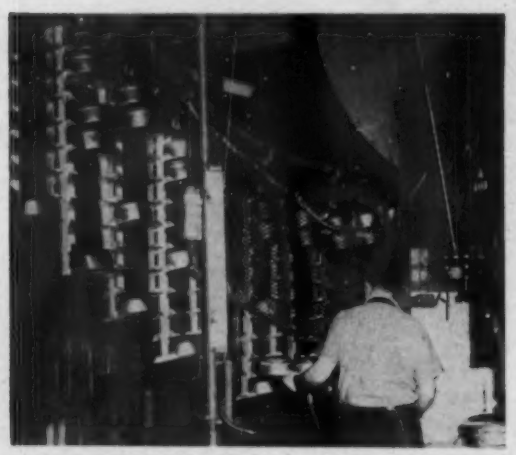
**LYCOMING DIV., AVCO CORP., Stratford, Conn.—This large battery of three-dimensional milling machines, utilizing card, tape and template controls, will be seen in operation, producing aft closures for second stage rocket chambers for the Minuteman ICBM, during the ASTME tour of Lycoming.**

Finish with Interferometers," for example, shows how different types of instruments are used to check surface finishes to accuracies measured by wavelengths of light.

One of the most exacting manufacturing operations found in industry is the production of the balls used in bearings. "The Application of Stylus Inspection Methods in Ball and Bearing Manufacture," a talk by Hoover Ball and Bearing Co. engineer Dale A. Cue, describes the application of instruments such as ball profilometers, ball wavometers, race wavometers and standard profilometers. All of these tests, intended to increase the accuracy and quietness of bearings, may be widely applicable to other, less specialized products.

Surface irregularities can be divided into three basic categories—surface finish, waviness and errors in form, says Fred W. Witzke in his talk, "Surface Finish and Other Surface Specifications." The importance of these categories—and the importance of developing surface specifications standards—are covered in the talk, with examples. Witzke is with Cleveland Instrument Co. and is chairman of the ASA sectional committee on surface finish.

When Gardner P. Wilson describes a "miniature variable dictator" in his talk, "A Measuring System for Displacements of Less than One Microinch," he is not referring to Fidel Castro—he is talking about an instrument with transistorized electronics that is capable of operating as a surface roughness analyzer or as a displacement indicator. His talk describes the instrument in detail.



**ELECTROLUX CORP., Old Greenwich, Conn.—Those attending the Electrolux Corp. tour, to be held on the second day of the Society's coming convention, will have a firsthand look at the manufacture of automatic vacuum cleaners and floor polishers. Here, rear covers for the vacuum cleaners are loaded onto a conveyor after being drawn from 0.020 steel in a 150-ton draw press. In addition to the draw press, the group will see Electrolux's Bliss automatic roll feed presses, Heald Boromatic machines, U. S. Multislide machines and six-spindle Greenlee automatic.**

The importance of good communications in metrology is stressed by Arnold W. Young, Engis Equipment Co. His talk is entitled "Understanding the Language of Metrology." Progress in manufacturing technique, he says, has advanced only to the capabilities of measurement, for you cannot make a product without having the initial capability to measure it or measure the components that together form the entire product. It follows, therefore, that manufacturing progress depends, pretty much, on engineers meaning the same thing—employing good communications—when they are using the language of metrology.

### Tool Engineering Progress

In fiber optics, the fact that light is transmitted by thin threads of glass and other materials is taken advantage of to make light travel around corners. S. M. MacNeille, American Optical Co., traces the recent developments in this field and shows how tool and manufacturing engineers can apply the principles of fiber optics to modern manufacturing and inspection equipment.

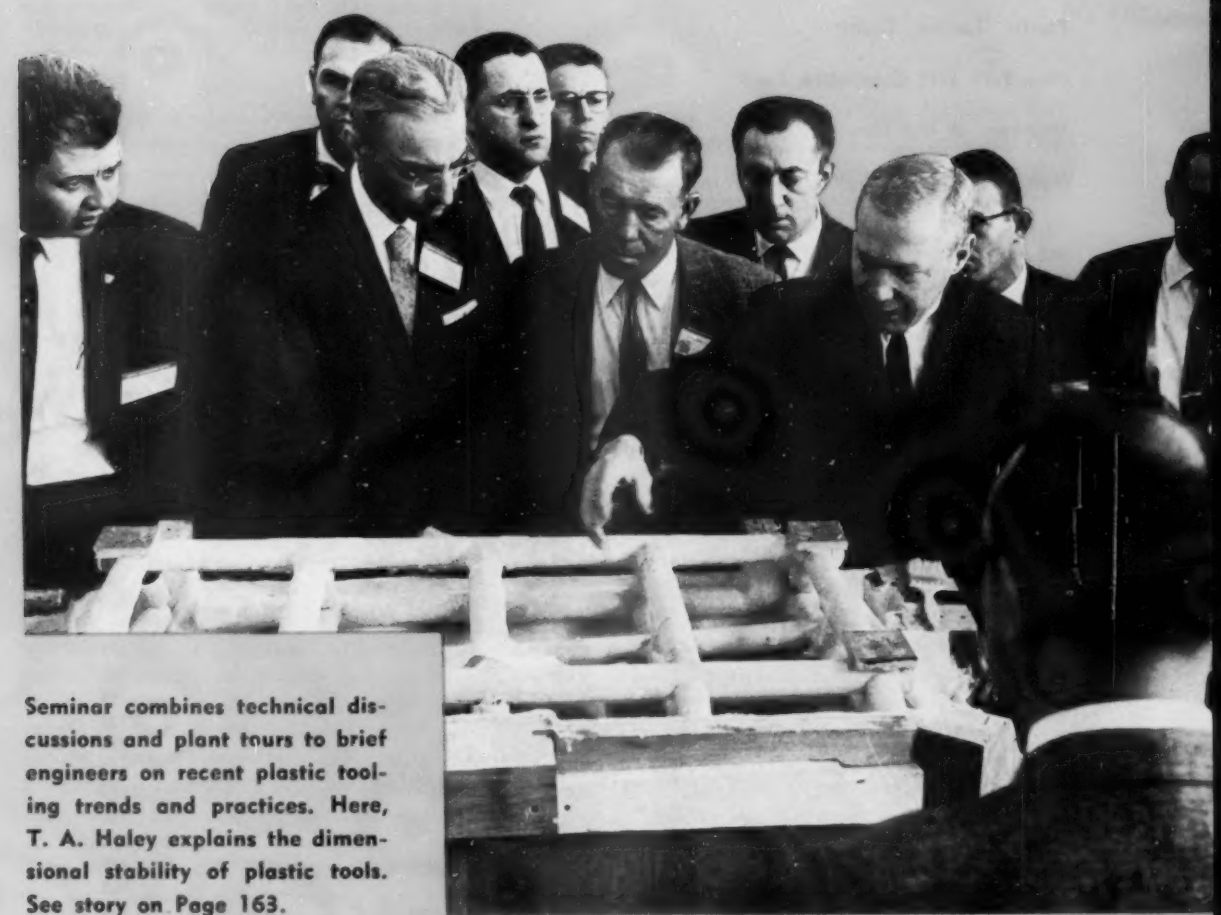
Existing tracer lathes may not be able to meet the extremely close tolerances demanded in the Space Age. The answer, according to four Lawrence Radiation Laboratory engineers, James B. Bryan, John E. Bowerbank, Jr., Earl D. Holland and Orland Mohl, is to make a close check of all elements of the lathe and servo system that may cause error. Once the sources of error are found, corrective action can be taken to bring tolerances in line. In their talk, entitled "Upgrading Tracer Lathe Machining Operations," they describe a tracer lathe check developed by the Lawrence Radiation Laboratory to locate and determine quantitatively the errors of machining with a tracer lathe.

Heat treating is one of the oldest—yet one of the most important—subjects to be covered by speakers at the Engineering Conference. Of particular interest is Vincent E. Matner's talk, "Instruments for Heat Treating," which shows how modern instrumentation leads to close measurement and control of time and temperature—the two major factors in successful heat treatment of modern materials.

Powder metallurgy, particularly as it applies to self-lubricating bearings, is the topic covered by J. J. Scott in his talk, "Self-Lubricating Bearings—the Whys and Wherefores." Manufacturing and processing of bearings, as well as their applications, are covered.

With the development of new adhesives, the adhesive bonding processes for joining metals is coming into greater prominence. "Effect of Catalyst Variations on the Bonding Properties of Epoxy Adhesives," a talk by Kenneth W. Carroll, Rubber and Asbestos Corp., explains how to get the best performance from these low-cost, versatile adhesives.

# news



Seminar combines technical discussions and plant tours to brief engineers on recent plastic tooling trends and practices. Here, T. A. Haley explains the dimensional stability of plastic tools. See story on Page 163.

## astme in action

# news section

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# Plastic Tooling Today

**Standing on a table, Richard Leasia explains the construction of a plastic tool. His audience is touring the Creative Industries plant in conjunction with the Plastic Tooling Seminar.**

THE SPEED at which developments in the field of plastic tooling are being introduced is sending many an engineer in this field back to school for a short refresher course. Such a short course was recently cosponsored by ASTME and the Society of Plastics Engineers. Some 65 engineers from all over the country gathered in the schoolroom—Detroit's Statler Hilton Hotel—to be taught by a faculty of some of industry's leading experts on all aspects of plastic tooling. The title of the two-day seminar was "Plastic Tooling Today."

Starting off the session with a bang, Orville D. Lascoe, professor of industrial engineering at Purdue University, used a 38-caliber shell to demonstrate explosive forming—a demonstration that helped to wake up his audience to the fact that epoxy plastic dies are sufficiently strong to withstand explosive forces.

Prof. Lascoe, who has just returned from an extensive tour of European operations, reported that with regard to designs and workmanship, European plastic tools appear to be at least comparable to our own. In many cases, he said, the proved practical knowledge of their technicians and mechanics is contributed as a supplement to reduce the tooling cost, rather than leaving the design entirely to the engineer.

Epoxy plastics, according to Prof. Lascoe, are the most satisfactory for tooling use because of the good surfaces obtainable and the favorable strength-to-weight ratios. A disadvantage of epoxies is that their strength is reduced at high temperatures, he added.

Ways of overcoming this disadvantage and making epoxy tools capable of withstanding temperatures up to 500 F, were discussed by Walter M. Stark, Jr., of H. Stark and Sons. He recommended making fiberglass-resin laminates or making fairly thick epoxy castings filled with exploded aluminum chips to give the tool greater heat conductivity.

Although most plastic tools are small, large plastic tools are being cast, mostly for aircraft stretch dies. Methods of making these large plastic dies were covered by Lewis F. Bogart, of the Marblette Corp. In discussing the setting characteristics of tooling resins and effects on fabrication and test methods, Bogart noted that the key to successful applications of plastic tooling is proper formulation of the plastic material itself.

A comprehensive talk on models and molds for plastic tooling was presented by Melvin K. Young, marketing manager of United States Gypsum Co. After describing mold materials and mold-making techniques, he showed how plastic-faced plaster is being applied for checking fixtures and Keller patterns. This combination of materials cuts time and costs for short-run tooling.

The use of plastic prototype models of new products for appearance, engineering and material evaluation studies was described by Peter W. Cherry, of Plastic Tooling Aids Laboratory. Plastic prototypes permit savings in final tooling costs, he said, because the product can be thoroughly evaluated as a three-dimensional model long before production tooling has been ordered.

Sandwiched in between the engineering discussions was an illustrated lesson in the practical application of plastic tooling. On the second morning of the seminar, registrants were given a first-hand look at two leading Detroit plastics plants.

At Artco Plastics Inc., Vice President T. A. Haley conducted the seminar tour and explained in detail the advantages of plastic "honeycomb" as a structural member for plastic tooling fabrication.

Richard Leasia was technical host for the tour of Creative Industries of Detroit. With a variety of examples he illustrated to the group the use of plastic wood for model construction.

# NEW YORK

A DYNAMIC ROUND of special events promises to match the pace of ASTME's upcoming convention with the high-speed tempo of life in the productive city where the event will be held. New York—with more than 15,000 manufacturing plants in a 150-mile radius, where one million people are engaged in the manufacturing industries, where four airports hum with the arrival and departure of 76 planes an hour, where people from the four corners of the earth gather—is just the environment for a meeting of 40,000 on-the-go engineers and industrial leaders.

Preceding the week-long program of manufacturing know-how is the annual Honor Awards Dinner on Saturday evening, May 20. The Society's highest national honors will here be conferred on six men for their distinguished contributions to industry.

On May 22 ASTME's $15-million Tool Exposition will be launched at an Exhibit Preview luncheon in the banquet room of the New York Coliseum. Industry's top leaders will be on hand to hear National Vice President David A. Schrom speak on the challenges facing the manufacturing world.

Another May 22 luncheon will honor Eli Whitney, the father of mass production manufacturing. At the Statler Hilton Hotel, Wallace E. Brainard, chief engineer at the Servo Machine Tool Div., Kearney & Trecker Corp., will trace the gradual evolution of Whitney's basic philosophy of manufacturing—"Put the Skill into the Machine"—when he delivers the annual Eli Whitney Memorial Lecture.

Highlighting the second day of the conference, May 23, is the "Race for Manufacturing Supremacy," a public affairs forum comparing the progress of Russian industry with that of our own. Composed of experts from industry, government and education, the panel will report on Russian technological advances observed during recent visits to Soviet manufacturing plants. Everyone is welcome at the discussion, which will be held at Columbia University at 2 p.m.

On Tuesday and Wednesday of convention week, the ASTME Board of Directors will hold their an-

# Sets Convention Pace

nual meeting at the Statler Hotel. All members are invited to attend.

A gala evening is in store for all who attend the Society's Annual Banquet on Wednesday, May 24. Besides a social hour in the Statler's Terrace Ballroom, the party will feature the installation of newly elected officers by retiring President H. Dale Long and a lively presentation—"How Is Your Sense of Humor?"—by humorist Tom Martin.

On Thursday, the National Education Committee will sponsor the Educators' Conference Luncheon in the Canada Room of the New York Coliseum. During a film presentation, "Creative Engineering," Melvin Sudheimer of General Motors Corp.'s Saginaw Steering Gear Div., will take his audience through the complete manufacture of a product, illustrating the relationship of all engineering activities in a typical American industry.

For the fairer conventioners, an equally active week is planned. Ladies' activities Monday through Friday will show the "Mrs." New York in style. After a get-acquainted party at the Statler on Monday, the ladies will be out sightseeing the following day. The tour will take them to Times Square, Chinatown and many other points of interest.

It's off to the United Nations Building for the feminine contingent on Wednesday. During the visit, they may be allowed to sit in on a UN session. Thursday will find the ladies cruising around Manhattan Island on a sightseeing boat. And Friday, "Design-O-Rama" promises a look at the latest products in all interior design fields during a tour of the Design Center for Interiors.

### Honorary Sponsors Stand for Progress

In line with the fast-moving pace of ASTME's convention, nine men who personify progress in American industry have been selected as the Honorary Sponsoring Committee for the conference and exposition. Executives and educators in the New York area, these honorary hosts are directly involved in the field of manufacturing.

Honorary sponsor Rudolph F. Bannow is president of Bridgeport Machines as well as chairman of the board and immediate past president of the National Association of Manufacturers. Dr. John R. Dunning, dean of engineering at Columbia University, pioneered the first neutron experiments in the U.S. and demonstrated the first uranium fission-nuclear energy release in this country. James R. Kerr, president of Avco Corp., has headed the corporation's Lycoming Div. and the defense planning section of the New York office. Republic Aviation president Mundy I. Peale served on the Hoover Commission Task Force on Procurement and has headed the Institute of Aeronautical Sciences.

Joseph A. Richardson, manager of Ford's Mahwah Plant, has previously managed several Ford plants throughout the country. Henry D. Sharpe, Jr., has for ten years headed the Brown & Sharpe Mfg. Co. Executive vice president and chief administrative officer of the National Association of Manufacturers, Charles R. Sligh, Jr., is an honorary NAM vice president for life. E. Clinton Towl, president of Grumman Aircraft Engineering Corp., is one of the six original founders of Grumman. Associated with the Radio Corporation of America since 1930, Arnold K. Weber is presently RCA director of manufacturing.

**The honorary sponsors of ASTME's 1961 Engineering Conference and Tool Exposition are men who know manufacturing from their own experience. Here, one of the nine honorary hosts, Henry D. Sharpe, Jr., president of Brown & Sharpe Mfg. Co., pauses during an inspection tour of his company plant.**

# Members in the News

DAVID N. SMITH, member of the ASTME Metal Cutting Project Committee, has joined the staff of Arthur D. Little, Inc., Cambridge, Mass., and is currently associated with the firm's management study on numerical control. Previously, Smith was with Jones & Lamson Machine Co., Springfield, Vt.

HOWARD C. MCMILLEN, past president of the Society and present chairman of the Research Fund Committee, has been promoted to general manager of Copeland Refrigeration of Canada Ltd. He was formerly manager of manufacturing at Copeland Refrigeration Corp.'s Sydney, Ohio, plant.

HANS ERNST, professor at the University of Cincinnati, is on a two-month United States Government assignment to Israel as an industrial adviser in metal processing. Ernst, a member of Cincinnati chapter, made the trip under contract with the International Cooperation Administration, which sponsors technical aid to underdeveloped countries.

Following a critical illness, T. B. CARPENTER, ASTME past president, has returned from the hospital to his home in Birmingham, Mich. While convalescing, he would enjoy hearing from his friends throughout the Society.

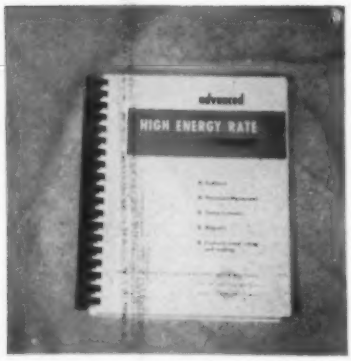
ROGER F. WAINDLE, past president and life member of the Society, has been elected president and board chairman of the Michigan Business and Defense Services Administration Executive Reserve. Formally organized under federal law, the Executive Reserve is a group of 71 industrial executives with government-service experience. In the event of a national emergency, the reserve members would serve in critical industries such as communications, transportation and production. Waindle is president of WaiMet Alloys Co., Dearborn, Mich.

National ASTME Vice President PHILIP R. MARSILIUS recently returned from a 7-week trade-building mission to Australia. Appointed by the U.S. Department of Commerce, Marsilius and four other American industrialists conferred with businessmen, industrialists, and provincial and government officials in Australia's key cities. The primary purpose of the mission was to find and recommend ways of furthering trade between the two countries in specific areas of industry and commerce. On the return trip, Marsilius visited both Japan and India.

Roger F. Waindle

Philip R. Marsilius

# New Book Covers High Energy Forming




**A compilation of the knowledge and know-how of 20 internationally known experts, *Advanced High Energy Rate Forming* contains nearly 300 pages of technical discussions, case studies and engineering data on high energy forming techniques, plus the most extensive bibliography ever compiled on this subject. The paper-bound book, which was published last month by the National Education Committee, is "another weapon in the armory of American industry," says General Manager Harry E. Conrad. Compiled from literature presented at recent ASTME seminars, the publication is concerned with production applications of high energy systems rather than pure research. Also covered in the volume are explosive fasteners and explosive metal-cutting and welding. A limited number of copies are now available at a charge of $8.50 to members and $9.75 to nonmembers.**

LONG BEACH, Calif.—Hard at work already, the newly elected officers of Long Beach chapter wrap up a recent chapter technical session. From left to right are First Vice Chairman R. Blake Boadway, Chairman Owen D. McDougall, retiring Chairman L. W. Allen and Treasurer Joe Cerato. Also filling offices this year are Ben H. Beveridge, and Buell L. Brown, Sr., second vice chairman and third vice chairman, respectively. *—Paul J. Bodnar*

# New Society Year . . . New Leaders

LANSING, Mich.—At a combined technical and installation meeting, Chapter 109 members heard Gerald L. Miller, Smith-Morris Corp., talk on "Equipment and Tools for Explosive Metal Forming." New officers installed by Leslie Bellamy, past president of ASTME, were: Leonard Sear, chairman; Layton Rugh, first vice chairman; Lyle Williams, second vice chairman; and Steve Stankus, secretary. Here, Arthur Reiser (right), past chairman, presents Sear with the chapter charter. *—Glenn Crippen*

HAMILTON, Ont. — New Hamilton District chapter chairman, Harold J. Boucher (right), fastens the past chairman's pin on Ron Tipping. Other new Chapter 42 officers installed by National Director A. J. Underwood, Jr., are Russell O. Wilson, John G. Wilson and Harold J. Millett, who are first, second and third vice chairman, respectively; Stanley R. Palmer, secretary and John O. Collins, treasurer. J. R. Oberholtzer, Carpenter Steel Co., Reading, Pa., was the evening's speaker. *—H. R. Roberts*

SYRACUSE, N. Y.—Robert Metz (left), immediate past chairman of Chapter 19, presents the gavel to his successor, Harold McNair. Looking on are: Robert Eaton (right), first vice chairman and Ray Adams, installing officer. During the ceremonies, Ed Luis was awarded the chapter's Annual Service Award. *—E. Luis*

**Governor Dempsey (right) signs the proclamation designating May 18 as Connecticut Tool and Manufacturing Engineers Day. John Cameron, general chairman of Connecticut Day, looks on.**

## Connecticut Day, May 18

CENTRAL CONNECTICUT—"In recognition of all they have done, and are doing, to improve our standard of living and advance civilization," Connecticut's Governor John Dempsey has proclaimed May 18 as the 13th Annual Connecticut Tool and Manufacturing Engineers Day.

On that day, Central Connecticut Chapter 148 will play host to the state's four other ASTME chapters —Fairfield, Hartford, New Haven and Danbury. The program includes plant visitations, a technical session and banquet, plus talks by Norman Paulton, Meta-Dynamics Div. of Cincinnati Milling and Grinding Machine Co., and Rudolph Bannow, chairman of the board of the National Association of Manufacturers and president of the Bridgeport Machine Co.

Some 500 engineers and industrial executives from Connecticut and the surrounding states are expected to attend the affair, says John Cameron, former Chapter 148 Chairman who is in charge of the Connecticut Day celebration.

*—H. W. Humphrey, Jr.*

## USU Seminar Explores Impact of Tape Control

LOGAN, Utah—The impact of numerical control in the industry of that area was considered during a recent seminar at Utah State University. Sponsored by Salt Lake and Ogden senior chapters and USU student chapter, the event was attended by 115 engineers and manufacturing executives. The program included two speakers from out of state: W. B. Johnson, Rocketdyne Div. of North American Aviation, Canoga Park, Calif., and F. E. Hibbard, Bendix Corp., Detroit, Mich. Johnson discussed "Numerical Control Systems." Also included in the program was a demonstration of tape cutting on a Friden Flexowriter. The seminar closed with an open-panel discussion by the two main speakers and Walter R. Catey, Marquardt Corp. Harry J. Todd, president, Todd Machinery, was moderator.

## Pittsburgh Tool Show Is Big Success

**PITTSBURGH, Pa.—Chapter 8's Second Annual Tool Show was a big success with 1200 attending and 27 companies exhibiting. At a dinner preceding the show, Chairman Edward L. Caughey, First Vice Chairman Robert Aikenhead, Second Vice Chairman Norman V. Cleary, Third Vice Chairman David Borland, Secretary Herman Dicome and Treasurer Thomas Nourie were sworn into office.** *—J. S. McAfee*

## Scholarship Awarded

**OAKLAND COUNTY, Mich.—Charles T. Gaffney, (right), Chapter 69 chairman, presents the chancellor of Michigan State University Oakland, Durand B. Varner (center), with MSUO's first engineering scholarship. Robert Nelson, president of Universal Oil Seal Co., watches. The award, a full-tuition scholarship for $279 annually, is named in honor of his father, Victor E. Nelson.** ***—Edward Teal***

## Diamond Tools Displayed

**WINDSOR, Ont.—Proving that "Diamonds are a girl's best friend," Harold Dillon of Detroit's Wheel Trueing Tool Co., recently told Windsor members how the gems are used in the manufacture of many household items used by the housewife today. Here, he explains a display of diamond tools to Jack Niklas (right) and newly elected Chairman Ray Smith (center).** ***—G. F. Burford***

## Tri-Cities Group Completes Textbook Section

TRI-CITIES—Climaxing their role in the compilation of the first textbook to be published by ASTME, *Fundamentals of Tool Design,* a special Tri-Cities chapter committee recently completed the textbook section titled "Design of Tools for Inspection and Gaging."

Organized and headed by Dan McKeon, Chapter 23's "Textbook Twenty" began gathering data and diagrams for their portion of the text last June. Eight months later they presented the completed manuscript to the National Technical Publications Committee. *—D. Bernard Cardinal*

**"Textbook Twenty" chief, Dan J. McKeon (right), presents his committee's completed manuscript to Willis J. Potthoff, vice chairman of the NTPC.**

## Flint Junior College Students Form Chapter

FLINT, Mich.—The latest ASTME student chapter—No. 34—was recently chartered at Flint Junior College. Attending their charter meeting were Francis J. Sehn, ASTME secretary, who performed the duties of officiating charter officer, and Gilbert E. Seeley, educational director of the Society, who gave the main speech. Thirty-seven charter members were on hand, among them the new officers: Francis W. Barton, chairman; Donald Lauderbaugh, first vice chairman; Roger Jennings, second vice chairman; Dave Durish, secretary; and Jerry West, treasurer. Dr. Searle Charles, assistant dean of the school, was also present to see the group's chairman, Francis Barton, receive an award for an outstanding scholastic record during his freshman year in mechanical technology.

At the new student chapter's first technical meeting, Michael Skund, process engineer at AC Spark Plug, gave a lecture and film presentation on cold extrusion. Also, tentative schedules were set up for plant tours and a joint meeting with the General Motors Institute Tool Club. *—Daryl H. Long*

## Students Take Charge

PEORIA, Ill.—At a meeting prepared by Peoria's student members, Edwin Sesseur (second from right), a state highway design engineer, spoke on Illinois' future highway plans. Discussing the program with him are (left to right): James Pitzer, student chairman; Harold Austin, student adviser; and Don Harter, technical chairman for the evening. *R. K. Hohulin*

## York Honors Bosses

YORK, Pa.—At Chapter 22's combined Boss Night and officer installation meeting, Donald W. Rohrer (left), retiring chairman, congratulates his successor, Thomas V. McMaster. Many of York's top industrial leaders turned out for the event, at which ASTME General Manager Harry E. Conrad spoke on "The Peaceful Revolution." *—J. George Williams*

## Indianapolis Honors Past Chairmen, New Officers

INDIANAPOLIS, Ind.—Past chairmen and new officers share the spotlight annually at Chapter 37. This year 14 past chairmen were present to see William Moreland, ASTME vice president, install Chairman Robert Mewhinney, First Vice Chairman Alfred Mendez, Second Vice Chairman Richard Spoor, Secretary Robert Pielemeier and Treasurer Charles F. Schanke.

Following the ceremony O. D. Lascoe of Purdue University gave a report of his recent visit to Poland on an assignment with the U. S. Department of Commerce. Prof. Lascoe relayed to the group some stark truths about the educational attainments among young people of Iron Curtain countries. He illustrated the point vividly by showing a picture of a young lady in her mid-twenties who, as a matter of course, had designed and built a double-ended contour lathe. *—J. J. Denney*


## positions wanted

MANUFACTURERS AGENT — seeking machine tool line, also special tooling line. Calling on medium-size shops, Detroit area and auto Big 3. Have good following—established contacts. Write to Classified Ads, Dept. 205, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURING ENGINEER AVAILABLE—Canadian emigrating to U.S.—8 years' experience in aircraft, turbine and electronics manufacture. Complete knowledge of machining, mechanical and electrical assembly and production trouble shooting. Presently employed in supervisory capacity. Will accept position with extensive traveling if required. Write to Classified Ads, Dept. 206, 10700 Puritan Ave., Detroit 38, Mich.

TOOL ENGINEER—experienced on all types of dies from small precision progressive to heavy stamping and drawing dies. Know steels and heat treatment. Expert machinist, diemaker, designer. Experienced in redesigning products and tooling for cost reduction. Three years as project engineer, eleven years in supervision and management. Engineering education. Desire challenging position of responsibility with progressive company. Write to Classified Ads, Dept. 207, 10700 Puritan Ave., Detroit 38, Mich.

## position available

EXCELLENT CIVIL SERVICE OPPORTUNITY—in Southeast United States for supervisor of process engineering and tool design with mechanical degree. Processing and tool design experience in job-lot precision machining and ability to give strong technical and administrative leadership. Immediate career opening for supervisory mechanical engineer GS-12. Salary range $8,955 to $10,255 per annum. For information, contact Employment Div., Industrial Relations Dept., United States Naval Ordnance Plant, Macon, Ga., or telephone SHerwood 3-5401, Ext. 264.

## special events

| | | |
|---|---|---|
| Connecticut Tool and Manufacturing Engineers Day | May 18 1961 | Waterbury, Conn. |
| ASTME Engineering Conference | May 22-26 1961 | Statler Hilton Hotel New York City |
| ASTME 1961 Tool Exposition | May 22-26 1961 | New York Coliseum New York City |

# Reports in Brief...

### Northeast

Members of ITHACA chapter recently heard Verne Loeppert, national treasurer, speak on the future challenges facing the tool engineer. The key to meeting these challenges, he said, is the ability to apply knowledge gained where best needed. . . . The 1961-62 officers for FRAMINGHAM chapter are: Seymour Benedetto, chairman; Walter Renfroe, first vice chairman; John Paulino, second vice chairman; Don Stohl, secretary: and Edmund Outhouse, treasurer. . . . GREATER NEW YORK chapter officers recently installed by National Director Arthur Cervenka are: Alfred Sampter, chairman; Milton Tanenbaum, first vice chairman; Frederick Seeman, second vice chairman; Ozzie Schwartz, secretary; and Roger Sutton, treasurer. . . . Officers of TWIN STATES chapter for the coming year are: Charles Chandler, chairman; John Millett, first vice chairman; Donald Whitney, second vice chairman; Michael Knoras, secretary: and William Herbert, treasurer. . . . Chartered last October with 90 members, DANBURY chapter is now a 106-strong group. The first chapter officers elected for a full term are: Wilbur Spafford, chairman; Harold Jarvis, Sr., first vice chairman; George Tibbitts, second vice chairman; John Harrington, third vice chairman; William Frank, secretary; and Edward Sharkany, treasurer. . . . New BINGHAMTON officers are: Glyn R. Williams, chairman; Joseph Pokarak, first vice chairman; J. L. Kuharik, second vice chairman; A. F. Gagne, Jr., secretary; and F. L. Higgins, treasurer.

### Midwest

KALAMAZOO chapter recently heard L. J. Haga, president of State Heat Treat, Inc., Grand Rapids, speak on "Heat Treatment of Aluminum." The group also presented its $100 semiannual Student Scholarship Award to George Regan of Western Michigan University. . . . Newly elected officers for DETROIT Chapter 1 are: Joseph J. Gabrick, chairman; Edward M. Till, first vice chairman; Henry C. Daum, second vice chairman; James J. Gambino, third vice chairman; Finney J. Allen, fourth vice chairman; Bert W. Bacon, secretary; and L. G. Ringholz, treasurer. . . . EVANSVILLE chapter recently installed Walter Lochmueller as chairman; James Dawson as first vice chairman; Robert Parker as second vice chairman; Louis Luker, Jr., as secretary; and Charles Kahre as treasurer. . . . CLEVELAND chapter reports a large turnout for the first executive meeting of their newly installed officers. . . . At the March meeting of the CANTON ASTME group, Wilbur Espenschied was installed as chairman and Mark Miller, treasurer, received a pin for outstanding service to the chapter. . . . Two national officers were recently the guests of MANSFIELD chapter. Vice President William Moreland spoke on "The Future of ASTME," and Secretary Francis J. Sehn, on "Press Automation for Stamping Plants."

### South

National Director Frank Ford recently installed these MISSISSIPPI chapter officers for the coming term: John Stefan, chairman; Robert Brenton, first vice chairman; Louis Stortz, second vice chairman; Joe Kelly, third vice chairman; William Luoma, secretary; and Dan Wells, treasurer.

### West Coast

Major Warren W. Harris spoke on the Air Force ballistic missile program at LOS ANGELES chapter's officer election meeting. New officers are: Russell Lamb, chairman; Frank Gonzales, first vice chairman; George Adams, second vice chairman; Lyle Wood, third vice chairman; Harry Schlentz, secretary; and Glenn Singer, treasurer. . . . SAN GABRIEL VALLEY chapter has elected Henry Schierhold as chairman for the new term. Other officers are: Kenny Allen, first vice chairman; Ray Donaldson, second vice chairman; Warren Prince, third vice chairman; Tom Osborne, secretary; and Jim Eddy, treasurer. . . . Some 220 members and guests of SAN FERNANDO VALLEY chapter turned out for Ladies Night and the installation of newly elected officers: Sam Longo, chairman; Ralph Marsden, first vice chairman; Robert Fraze, second vice chairman; Norman McMichael, third vice chairman; Ralph Garcia, secretary; and Walter Ott, treasurer.

# V-R INSERTS...

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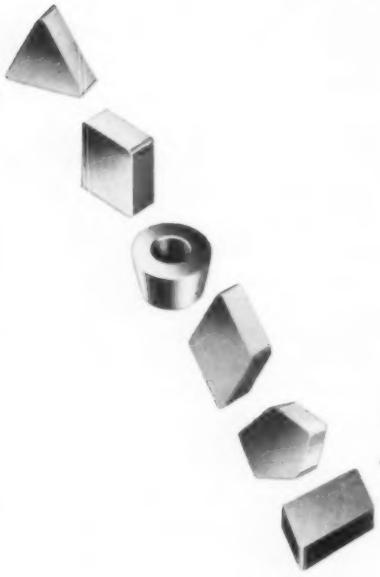

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# Progress in Production

## LATHE CUP SOLVES CONCENTRICITY PROBLEM

**Setup for boring and reaming resilient laminate. End piece held by operator is screwed on lathe fixture secure workpiece in cup.**

In boring or machining internal diameters in round, laminated plastic parts, the natural resiliency of the material often makes it impossible to hold concentricity closer than 0.005 inch. Ordinary chuck jaws introduce lateral compression on the edge of the work and faceplate clamps exert axial compression at localized points on the face of the work.

Because it puts the work under uniform, axial compression, a lathe cup used by Taylor Fibre Co., Norristown, Pa., holds concentricity on gear blanks, bushings, bearings, pulleys and similar parts to 0.001-inch tolerance. The cup consists of a piece of laminated phenolic plastic tube or sheet stock machined to dimensions that are slightly larger than those of the workpiece. When the workpiece is inserted into the lathe cup, a cap screwed onto the end of the cup, holds it firmly. A hole in the cap permits the tool to machine the inside diameter of the workpiece.

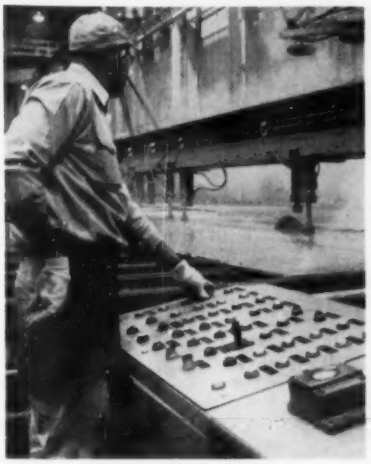
Taylor has used the lathe cup successfully for close concentricity boring of virtually every machinable grade of laminated plastic. Added results are reduced setup time, increased machining feeds and speeds and the elimination of chipping. Even where concentricity is not critical, the cup is useful, since a number of thin parts can be stocked in the cup holder and drilled, and bored without separate setups.

Concentricity, however, is generally difficult to maintain on workpieces longer than 4 inches. Another limitation is that, although cups can be stored and reused for repeat orders, it is normally easier to make a new cup than to remount the cup with the precision required for close concentricity limits.

## GIANT SAW MACHINE CUTS HIGH-STRENGTH ALLOYS

After an initial breaking-in period, an automated circular sawing machine for aluminum alloy plates is now in full production at Kaiser Aluminum & Chemical Corp.'s Ravenswood Works in W. Va. In operation, the saw cuts parts up to 64 ft long, 14 ft wide and 6 inches thick. Its operation is closely related to that of the adjacent plate stretcher having a pulling capacity of 30 million lb. Although a wide variety of aluminum alloys is processed, the installation's principal use is in the stretching and sawing of the 5000 aluminum group.

Designed and built by Loma Machine Manufacturing Co., Inc. of New York, the automated plate-handling equipment consists of a charging table for entering the stock into the rip saw, a delivery table for removing the stock out of the rip saw into the cross cut or end trim saws and a runout table for discharging the finished plates. In operation, each plate is loaded by crane onto the charging table receiving racks which are clad with Micarta. The plate is moved into the rip saw path by an automatic pusher drive which cuts out as soon as a series of stops on the delivery table are hit. At this point the air-operated hold-down clamps located on both sides of the saw path are low-



**Saw in operation cutting high-strength aluminum alloy. Console (foreground) controls machine functions.**

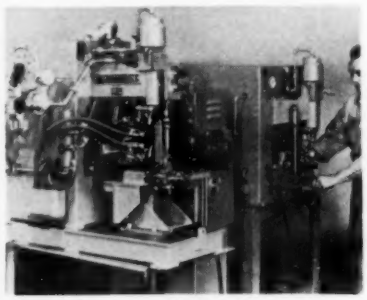
ered, the length stops in the table retract, the air-oil mist lubrication system cuts in, and the rip saw begins to cut.

The 64-ft-long rip saw employs a 30-in-diam carbide-tipped saw blade driven by a 60-hp motor at a peripheral speed of 12,000 fpm. Feed rates of 5 to 45 fpm are available during the cutting cycle, and there is also a 200 fpm rapid-return rate. The cross cut and end trim saws are all similarly designed, except that their length of cut is only 14 ft.

When the rip-saw cut has been completed, the hold-down clamps open and the cut plate is moved out of the saw path by a set of belt conveyors. Subsequently, the plate is transferred by means of the reversible delivery table rollers to be similarly cut by the cross cut or the end-trim saws. Finally, the plate is moved onto the runout table, which is equipped with driven transfer rollers. It is then ready for crane pickup and transfer to the shipping or heat treating bay for further processing.

## WELDING AND ASSEMBLY OPERATIONS COORDINATED IN ONE MACHINE

A dual welding machine system recently designed by Thomson Electric Welder Co. has multiple capabilities in that it welds a base, spacers and free stems to diaphragm plates 0.004 inch thick, and then seam welds a tier of up to ten plates in pairs. The unit that assembles individual components is a 30 kva spotwelder tooled with three quick-change electrodes that are designed to accommodate variable size parts. The second unit, for seal welding a sandwich of two plates and a spacer, a stem or a base, is a 10 kva machine fitted with supporting mechanisms and a variety of quick-change tooling.

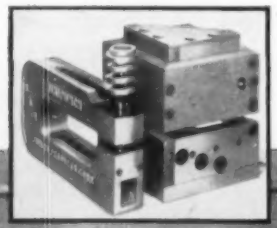


**Coordinated welding and assembly machine. Quick-change tooling simplifies changeover from one job to another.**

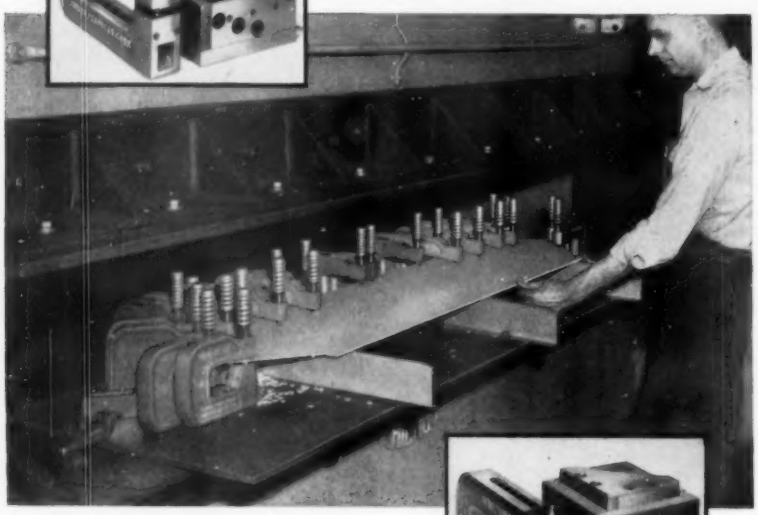
Measuring approximately 18 x 24 x 28 inch over-all, the spotwelder fits on either a portable or stationary stand. The 30 kva transformer, water-cooled and providing eight points of heat, is located in the rear section of the frame and is easily accessible. A press-type, antifriction head operates by a single-acting air cylinder with spring return. Pressure is 700 lb at 80 psi and piston stroke is $1\frac{3}{4}$ inch.

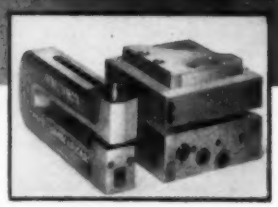
Electrode changing is facilitated by a spring type ejection mechanism built into the upper tip holder. Three lower electrodes, each of which is machined to contain either a base, spacer or free stem, and diaphragm plate, are provided with the machine. Knockout pins in the electrode holder permit a rapid change from one to another.

A single-stage foot switch controls the welding circuitry. When depressed, it initiates a timer, causing the head to descend. Welding current is then focused around a small angular projection ring on the face of the work. Deflection of the C-frame during the welding cycle is counteracted by two heavy steel rods connecting the lower electrode holder to the upper frame. Welding pressure is exerted as a straight-line force which is equal at all points around the projection ring.

**UNIPUNCH SERIES "A"** Hole Punching Units punch round and shaped holes up to 3" in diameter in up to ¼" mild steel (Series "AH" for up to ½" thick). Notching Units for corner, edge, vee and special shaped notches may be used in combination setups with hole punching units. Both types of Series "A" Units have popular standard 8¾" shut height and 3½" die height.





**UNIPUNCH SERIES "B"** Hole Punching Units punch round and shaped holes up to 3½" in diameter in up to ⅛" thick mild steel or equivalent. Standard or special Series "B" Notching Units may be used in combination setups. Both types of Series "B" Units have popular standard 5½" shut height and 2$^{19}/_{32}$" die height.

# How UNIPUNCH Hole Punching and Notching UNITS save time and cut costs

Unipunch Tooling System produces custom setups with standard units. Simply set up the units outside the press according to the desired hole punching and notching pattern; slide onto press bed; and start producing parts with first stroke of ram — *nothing attached to press ram.*

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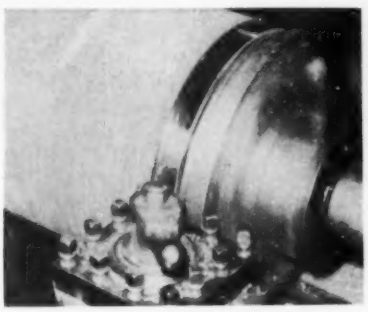
On the second machine a maximum of ten diaphragm plates—or five sandwiches—can be stacked and circumferentially seam welded in pairs. Diameters of from $1\frac{11}{16}$ to $2\frac{1}{2}$ inches can be mounted in the same tooling device. This welding unit—a 10 kva model AO-6 measuring 13 x 33 x 33 inch—has a driven lower electrode wheel with variable speed controls, rotational control, fine spray water cooling, and a parts positioning device which, by a variable tensioned spring, permits the operator to seam weld each sandwich in the diaphragm stack without changing horizontal alignment.

## CEMENTED OXIDE TOOLS CUT MACHINING TIME

Application of Carboloy(R) cemented oxide grade 0-30 to the turning of centrifugally cast cylinder liners and sand-cast pistons has resulted in appreciable savings in machining costs. In the past, two cuts, requiring a total of three hours, floor to floor, were necessary to turn the $18\frac{7}{8}$-inch OD by

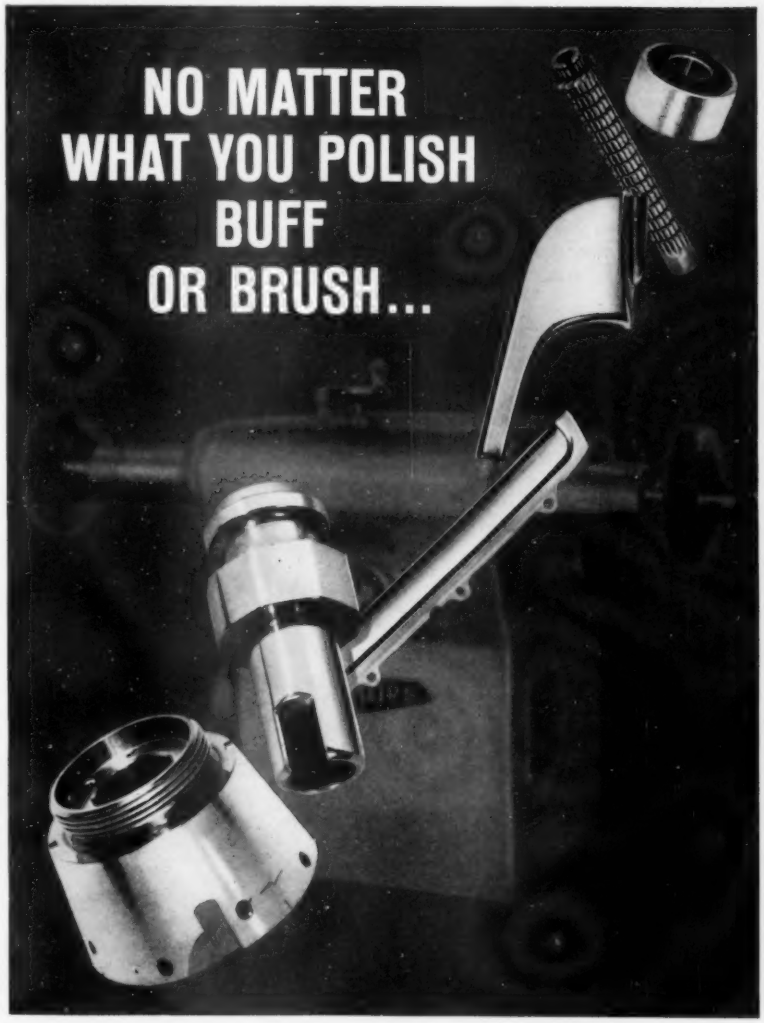


**Cemented oxide tooling applied to the turning of a sand-cast piston. Disposable inserts are used in this application.**

$46\frac{1}{2}$-inch long liners to the required 18.525-inch diam. Through use of the cemented oxide, machining time was cut to one hour, floor to floor. Actual machining time is only 15 min. Tool life also has increased because two liners per index can now be turned. In addition, the diameter is held to 0.002 inch for the full length of the piece, an important factor since the liners are turned to size for grinding. The tooling used is a SQT-245P5 disposable insert with a $\frac{1}{64}$-inch wide negative rake land.

## HIGH-ALLOY CASTINGS ELIMINATE HEAT AND CORROSION PROBLEMS

To solve the problems of high temperature, stress and corrosion inherent in vehicular gas turbine engines, engineers of the Allison Div. of General Motors Corp., Indianapolis, Ind., have made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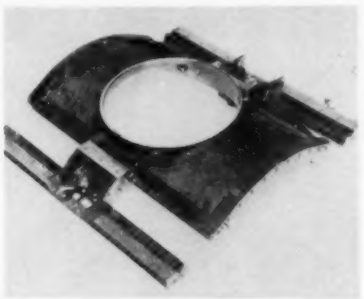
liberal use of high-alloy castings in the design of the GMT-305 Whirlfire regenerative gas turbine engine.

The GMT-305 is a multifuel engine, designed to burn practically any of the normal types of fuel associated with internal combustion operation—gasoline, kerosene, or the heavier diesel fuels. It develops a rated horsepower of 225, which is more than double the output of a comparably sized piston engine and approximately 70 percent more power per pound of weight. This high concentration of power in a small, lightweight unit means that every working part is highly stressed, operating temperatures in the combustion zone are high (1600-1700 F), and the products of combustion are corrosive.

To handle this combination of extreme operating conditions in such a highly concentrated weight-size package, castings made of SAE 60347 alloy are used for six important components in the hot area of the Allison engine. These are the transition liner support, gasifier turbine casing, engine bulkhead, turbine nozzle housing and support, and upper and lower bulkhead extensions.

These parts vary in size from an 11½-inch OD ring, with ¾-inch by 2-inch cross-section, to a 24-inch square bulkhead, with a ¼-inch wall thickness. They range in weight from 4¼ to 54½ lb. The location of these castings in the hottest sections of the engine and their ability to confine and utilize extremely hot combustion gases points up the necessity of using a metal having good temperature and corrosion resistance characteristics plus sufficient strength to withstand the high thermal and mechanical stresses created in the engine.



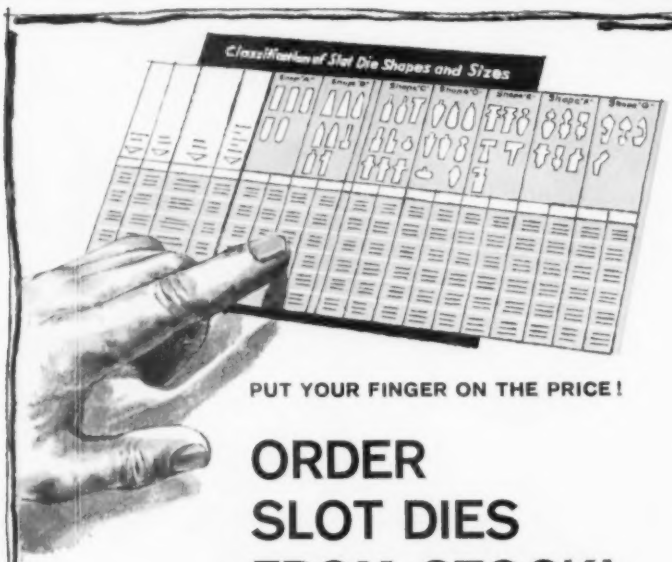
**Redesigned engine bulkhead. Three components replace complex welded assembly formerly used.**

## SPECIAL MILL USES STANDARD COMPONENTS

High production in the notching of ½-inch steel plates has been made possible by a special milling machine designed and built by U.S. Burke Machine Co. Providing the rigidity demanded by long-run, quantity production, the special machine consists of a basic double column Hy-Flex Mill with hydraulic longitudinal table feed, horizontal spindle and dovetail overarm. The opposed double column V-ways provide exceptional support for the massive knee, and the dovetail overarm is securely anchored to both stud columns, which have finished machined tops approximately 12½ inch square.

By means of multiple V-belts, the 5-hp drive motor transmits power to a helical gear speed reducer connected to the spindle. The spindle head may be moved in and out by means of an acme screw which positions the cross slide on which it is mounted. Vertical location of the table is also controlled by a manual leadscrew feed.

In production, special fixturing enables the machine to hold 12 of the ½ inch thick steel plates. Dual cutters, cooled by spray mist and operating at 110 rpm, mill the notches in one pass.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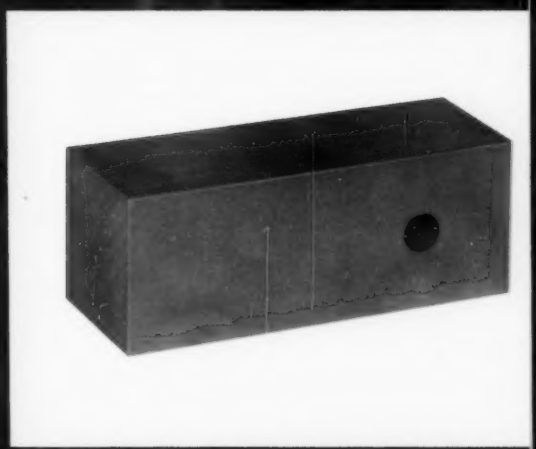
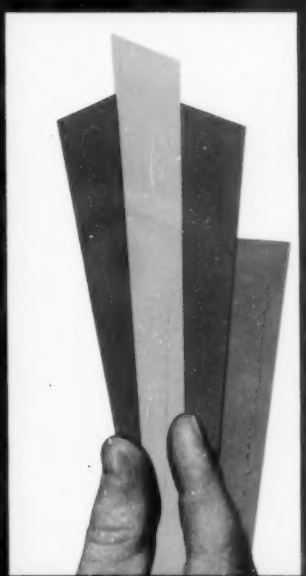


AND THESE FOUR COLORS . . .



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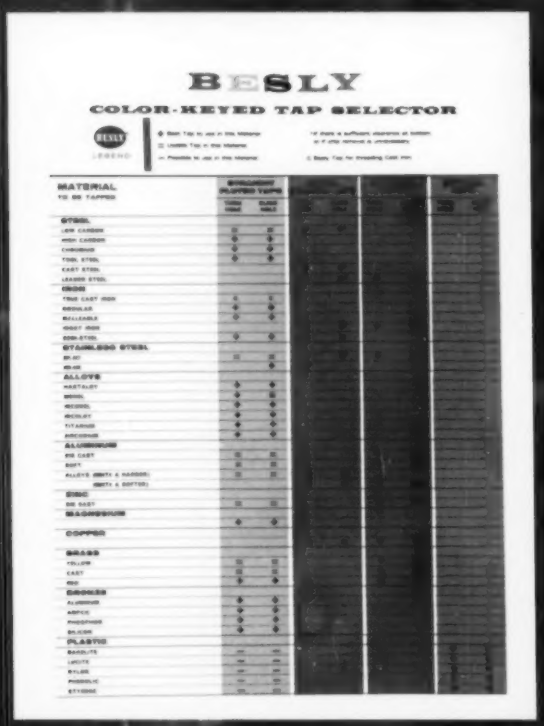
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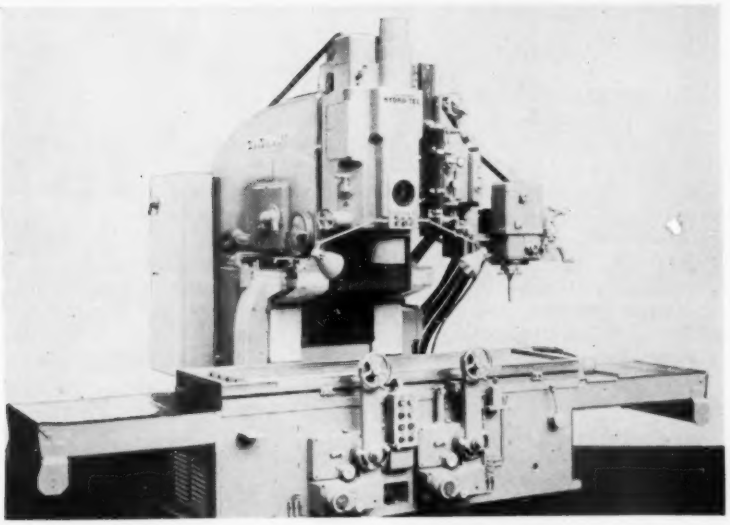
# TOOLS of today



## Milling Machine Does Die Sinking

General purpose manually controlled milling, die sinking, automatic profile milling and multiple spindle production milling can be handled by the 28-inch vertical Hydro-Tel milling machine. The machine has a cross slide and vertical head, with horsepower ratings 50 to 100 percent greater than previous models.

All hand and power feeds are hydraulically actuated to provide manual traverse of slides and infinitely variable feeds. Table and cross slide levers have five positions for engaging feed and rapid traverse in either direction. Independent of each other, the table, cross slide and vertical heat feed rates can be engaged separately or together.

The table and cross slide feeds are variable from 1 to 25 ipm or ½ to 12½ ipm. The vertical head feeds range from 1 to 15 ipm. The machine has 16 spindle speeds, six optional ranges for the 10 and 15-hp drives and four for the 20-hp drive. It can be equipped for many types of work including automatic depth control for die sinking; 360-deg automatic profiling, with or without conventional manual control; combination automatic depth control; and 360-deg profiling and automatic die sinking cycles with pick feed.

Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **Circle 401**

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## Overload Pitman Stops Press Damage

Among the operations to which this hydraulic overload pitman can be applied are briquetting, coining, embossing, marking, pressing, riveting, sizing, stenciling, staking, subassembly and swaging. Provided with a pressure pump and easily installed on any power press, it eliminates damage to the press, crank and frame. The calibrated relief valve can be set at any desired working tonnage. Because it maintains a constant oil pressure in the pitman cylinder, the pneumatic pumping unit keeps the pitman precharged to the desired working pressure at all times. The relief valve is controlled by an automatic regulator.

Dayton Rogers Mfg. Co., Minneapolis 7, Minn. **Circle 402**

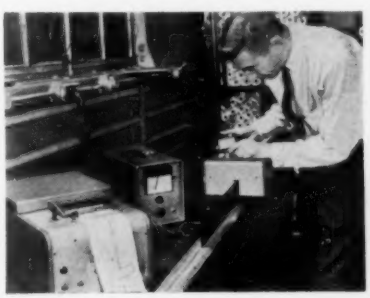
## Four-in-One Press Has Wide Work Range

Instead of riding on the shaft, the pitman of the Varistroke press is mounted on an eccentric tapered bushing whose position can be changed and locked to any one of four marked locations to obtain the desired stroke. Stroke range is from ½ to 1½ inches or, on larger presses, from 1 to 3 inches. The adjustable stroke mechanism consists of two key parts—the bushing and a locking ring nut. The locking ring is an integral part of the shaft. The stroke is changed by loosening the mechanism ring nut and bushing which, in turn, disengages the key. The key is then realigned with the slot on which the desired dimension is marked. Tightening the ring nut presses the key into the desired slot, making the press ready for operation.

Dechert Dynamics Corp., Palmyra, Pa. **Circle 403**

## Device Measures, Records Thickness Variations

Three units make up the Microcorder: an amplimeter, a recorder and a piloter. Working together, they measure and record variations in the thickness of metal strip. The amplimeter amplifies electronic signals from the tracer as it is piloted along the strip stock. A selection dial gives five vertical magnifications from 250X to 50,000X. The recorder, which has three horizontal magnifications from 50X to 250X, permanently charts a record of the vari-

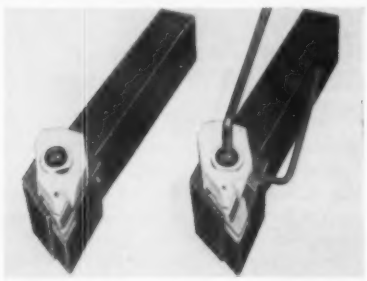


ations. The self-propelled piloter contains the tracer mechanism and will traverse an 8-inch strip in 90 sec.

Micrometrical Mfg. Co., 3621 S. State Rd., Ann Arbor, Mich. **Circle 404**

## Negative Rake Toolholder Is Adjustable

Illustrated are two views of the negative rake, tracer type Adjust-O-Breaker toolholder, showing the range and method of adjustment. Change in the breaker position is made by loosening the clamp screw on the top and turning the adjusting screw on the side. Because the side adjusting screw has a wrench socket at each end, adjustment can be made at the machine from either side of the tool.



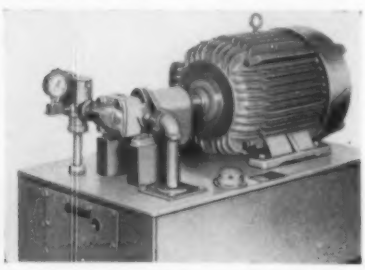
Use of an elongated diamond-shaped carbide insert eliminates rotation when the cutting load is applied. The ends are identical, permitting indexing. This toolholder is available in two styles and seven sizes.

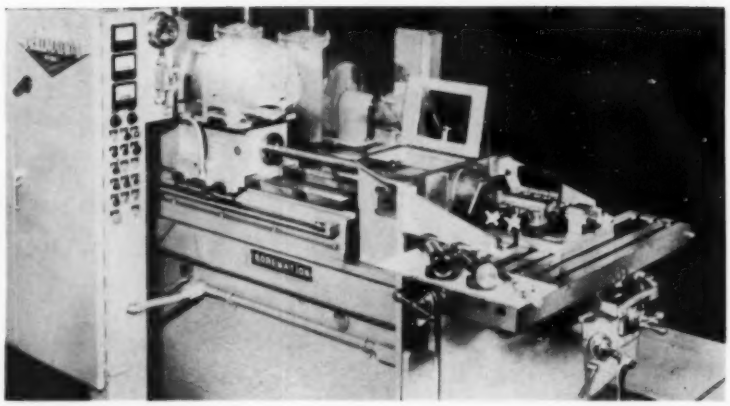
General Electric Co., Detroit 32, Mich. **Circle 405**

## Hydraulic Power Units Convertible to 2000 psi

To meet possible increased power requirements, 11 of 13 VSP hydraulic single pump power units can be converted to 2000-psi units by installing a motor of additional horsepower. All 13 models are offered with reservoir capacities from 15 to 60 gal and pump capacities to 35 gpm. The units are equipped with a separate relief valve and incorporate an 1800-rpm motor.

Hannifin Co., 501 S. Wolf Rd., Des Plaines, Ill. **Circle 406**





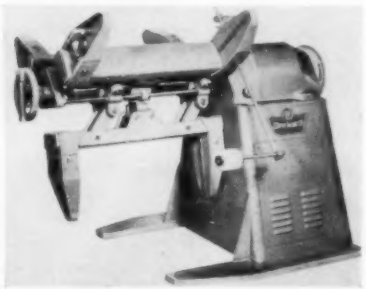
## Monitoring System Halts Scrap, Drill Breakage

Illustrated is a jig Boremation gun-drilling machine equipped with the Monitor Control electronic safety system. Monitoring each danger area during the drilling cycle, the control system is incited into action by any deviation from normal operation. The drill stops feeding and the cause of the malfunction is pinpointed by the dials on the control panel so that corrective measures can be taken before the workpiece, tool or machine is damaged. Another feature of the machine is the simplicity of operational sequence. Once the workpiece is clamped into position, the MC automatically finishes the complete operation in one pass. The dials also tell the operator the condition of the tool, workpiece density, spindle rpm, coolant flow, coolant pressure and feed rate.

Drillmation Co., Inc., 6500 E. Eleven Mile Rd., Center Line, Mich. **Circle 407**

## Powered Stock Reel Feeds Stamping Presses

Stock weighing as much as 2500 lb can be supplied at controlled rates to stamping presses and accessory feeding equipment by the Model 2500-24MB powered stock reel. Operation control is through a free loop arm actuating a stop-and-go mercury switch and an electric disk type brake. Coils are automatically centered and balanced and outside stockkeepers can be adjusted for loading on the three support arms. Parallel rule type inside diameter adjustment is accomplished from the front of the reel. The unit is available in 12, 18, and 24-inch stock width sizes with maximum outside diameters of 40 inches and inside diameters from 15 to 20 inches. Both powered and nonpowered models are offered. Powered models have a 1½-hp, 220/240-volt, 3-phase, 60-cycle motor with right angle drive.



Cooper Weymouth, Inc., 600 Honeyspot Rd., Stratford, Conn. **Circle 408**


**Need Information Fast?**

**If you need information on machines, tools, tooling, manufacturing equipment of any kind, consult the Manufacturing Engineering Information Services section of THE TOOL AND MANUFACTURING ENGINEER's March 15, 1961 issue. Fifteen hundred product classifications are covered, and 2000 national sources and 21,000 local sources of information on these products are listed, with names, addresses and telephone numbers.**


## Machine Punches, Verifies Control Tapes

Codes punched in eight-channel tape can be prepared and verified by this Flexowriter and motorized tape reader. An automatic writing machine, it code-punches tapes for controlling all types of metal removing machines. Typical applications include measuring spot welding and controlling forming machines and rolling mills.

As a proof document is being typed, a by-product tape is punched simultaneously. This tape is inserted in the tape reader. The document is then retyped. As each character is keyboarded,

its assigned code is compared with the original code being read in the motorized unit. If the two codes match, the writer will punch the verified code in a new tape. If the codes do not compare, the keyboard will lock.

To determine where an error has occurred, the operator checks the visible proof of the second typing or the original tape in the reader, unlocks the keyboard by touching the error reset switch and, again simultaneously, types the correct character and punches its code equivalent in the second, or verified, tape. The machine also has a device on

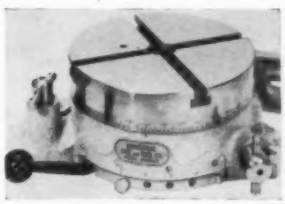
its punch to check for odd bits or holes that make up each code.

The Flexowriter uses a one-inch-wide paper tape. Code holes are numbered 8 to 1 from left to right facing the leading edge of the tape. Feed holes are punched between the 4 and 8 code holes 0.394 inch from the right edge of the tape in line with the code holes. Ten codes are punched in each inch of tape.

Friden, Inc., 97 Humboldt St., Rochester 9, N. Y. **Circle 409**

## Indexing Unit Has 40-Sec Accuracy

This unit provides indexing for milling, drilling, grinding and other toolroom and production machining operations. By changing the selector button the user has a choice of 2, 3, 4, 6, 8, 12 or 24 divisions—with accuracies of 40 seconds or better—without the installa-



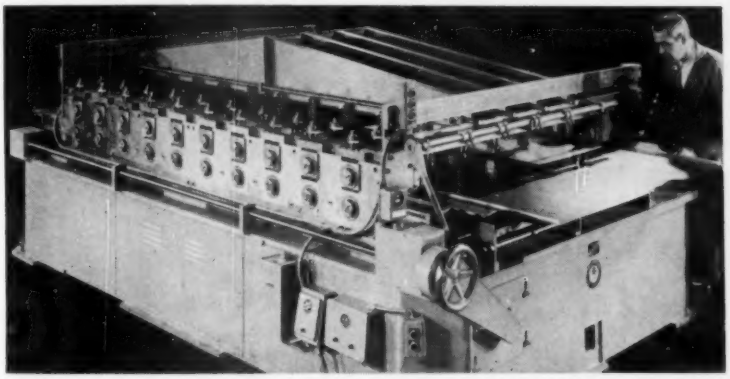
tion of special masking plates or blockouts. The unit is available in 9-inch-diam T-slotted or plain platen models or 8-inch chuck models. Automatic locking after indexing and an additional clutch type lock prevent deviation or offset during operation. The unit can be used in either the vertical or horizontal position.

Universal Vise and Tool Co., Parma, Mich. **Circle 410**

## Roll Forming Machine Has 10 Stations

This model roll forming machine, PTR 55-10, produces steel panels in widths from 8 to 66 inches, forming both edges in one pass, at speeds of 40 to 120 fpm. It has a motor drive to the movable head and can change position in 40 sec. Because it has two sets of roller dies, the production of two different types of panels in any of the many widths required is possible. Sheet supports, placed down the center of the machine, provide adequate support for wide sheets. A visual reading counter shows the position of the movable head in inches and sixty-fourths. The machine is powered by a 10-hp, 3-phase, 440-volt motor.

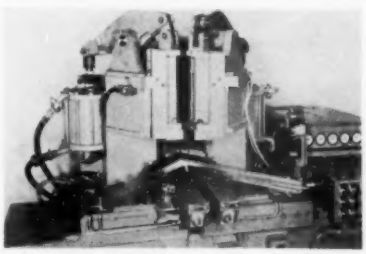
Maplewood Div., Rockford Machine Tool Co., Rockford, Ill. **Circle 411**



## Flash Welder Has Compound Clamping System

One feature of the Model F-3 flash welding machine for joining mitered corners of extruded aluminum members is a bidirectional clamping system. Two more features are welding dies that nest in the extrusion and adjustable components that allow up to one degree of angular variation to compensate for parts shrinkage.

The clamping system comprises two compound press clamps which hold the



work in both a horizontal and vertical plane during the weld cycle. Horizontal force is 7000 lb transmitted to each workpiece through mechanical leverage from an 8-inch-diam cylinder operating on 80 psi air pressure. Timed to coincide with the completion of horizontal clamping, the vertical clamps descend to apply 10,780 lb of force. The vertical cylinders measure 10 inches in diameter. When all clamps are closed, the work is aligned to give exact perpendicularity in the resulting joints. The design of the pneumatic system and circuitry permits different clamping sequences.

The welding cycle is controlled by a mechanism that produces 13,000 psi upset force at 80 psi air pressure through the movable right-hand platen. This arrangement—comprising a pushup air cylinder, a crank and linkage system, a hydraulic snubbing cylinder and an adjustable flow valve—provides a flashing cycle that follows a true parabolic curve. Thus, the transition between flashing and upset occurs so that upset acceleration exceeds that obtained through conventional cam or hydraulic machines.

Thomson Electric Welder Co., 161 Pleasant St., Lynn, Mass. **Circle 412**

## Positive Rake Holders Have Adjustable Clamp

Positive rake holders have been added to the Dex-A-Tool line of throwaway insert toolholders. Available in various styles and shank sizes, these right and left hand holders have an adjustable carbide faced combination chipbreaker clamp. The clamp has buttress type serrations and a setscrew located at the rear to permit rapid relocation of the clamp after indexing or replacing the insert. Another feature is an indexable and replaceable carbide anvil which provides extra rigidity and insert support and protects

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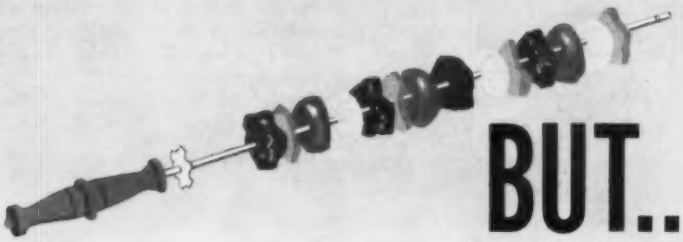

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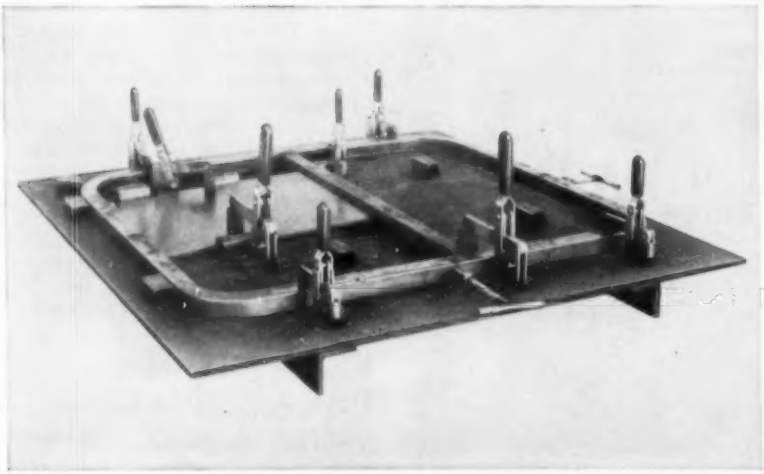

Steel welding fixture with 8 De-Sta-Co Toggle Clamps holds 6 parts solidly in position during welding.

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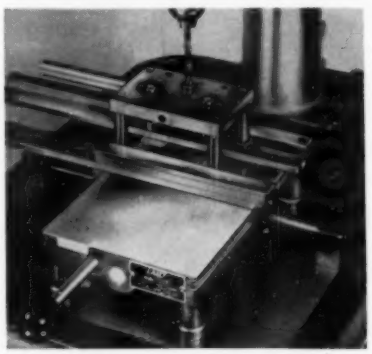
the shank. These holders are designed for applications involving long small diameter workpieces, refractory metals, austenitic high-temperature alloys and nickel base alloys where negative rake holders are not suitable.

Adamas Carbide Corp., Kenilworth, N. J. **Circle 413**

## Device Holds Work Without Clamping

This device, known as Slide Lox, holds work on drillpresses and tapping machines without clamping. Securely locked against turning and lifting, it gives complete freedom of motion in



any direction. It eliminates the need for slots and tapped holes in the table and locks in the crosswise or lengthwise position or both. It is available as a vise and fixture base in two sizes in aluminum or semisteel.

Lassy Tool Co., Plainville, Conn. **Circle 414**

## Plotting System Checks Out Tape Programming Errors

Compatible with most digital computers, the Model 570 magnetic tape plotting system produces an X-Y plot of digital data on a recorder to check out magnetic tape for numerically controlled machine tools. Thus, errors in tape programming can be caught and corrected. Its digital operation eliminates analog conversions or servos and the problems of drift and response.

Operations are flexible in that plots can be superimposed on work done at a previous date; functions can be distinguished by color with a 15-sec change of recording pens; and functions can be plotted beginning at the end of previous plotting.

Plotting is automatic with zero posi-

tioning, scale factor adjustments, curve and symbol identification all controlled by the computer programmer. Although continuous curve plotting is done at the rate of 2 ips, 30 seconds' plotting can be recorded by the computer in one second. Point plotting is accomplished at 175 points a minute. All types of symbols or characters from 0.1 inch and larger can be recorded. The tape transport will read magnetic tapes having a linear density of 200 bits an inch.

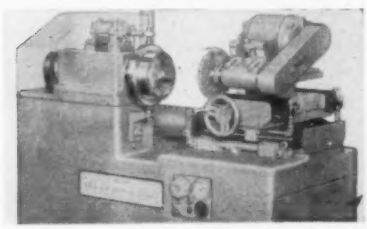
USE READER SERVICE CARD ON PAGE 213 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

The auxiliary Model 560R digital X-Y recorder uses a bidirectional rotary step motor on both axis drives, each step causing the drum or pen to move 0.01 inch in a positive or negative direction. It will accommodate paper rolls 12 inches wide by 120 ft long. The pen is raised or lowered as many as 10 times a second. All circuitry of the system is solid state.

California Computer Products, Inc., 8714 Cleta St., Downey, Calif. **Circle 415**

## Building-Block Machine for Inside, Outside Grinding

While this machine is of individual design for a specific application, it is—because of its building-block construction—adaptable to a wide range of internal and external grinding operations. The grinding wheel head, powered by a ½-hp motor, permits interchanging the 6-inch wheel external spindle with internal spindles. The manual cross feed will adjust the wheel head in position for internal grinding or external grinding. Additional versatility is provided by the pendant type switch panel which allows manual, semiautomatic or completely automatic operation. The horizontal traverse is powered by a hydraulically controlled air cylinder. Continuous reciprocation with variable traverse speed and variable stroke from zero to 8 inches is possible because of the machine's adjustable trip rod with limit and solenoid switches.



Standard Electrical Tool Co., Cincinnati 4, Ohio. **Circle 416**

## Miniature Four-Way Valves for Oil Hydraulic Systems

This line of miniature directional valves is designed for use in small volume oil hydraulic systems such as those for jig positioning and clamping, gear shifting and clutching on machine tools and venting on relief valves. The valves are suitable for operation to 1000 psi and have a maximum capacity of 2 gpm. Designated DIL, these gasket-mounted valves are four-way, offered in both single and double, a-c and d-c solenoid models. They are available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- The air released on the upward stroke of the press can be utilized for ejection of small parts.

Shown here is model PH-3, which develops 1700 lbs. pressure. LIP model PH-2 has a force of 500 lbs.

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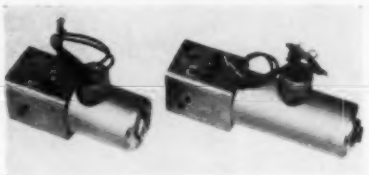


in various spool types to suit operating requirements. One valve in the line, having alternate ⅛-inch pipe thread cylinder port connections located opposite the mounting face, is particularly suitable for mounting a series of valves on a mainfold.

Vickers Inc., Detroit 32, Mich. **Circle 417**

## Device Measures Finishes from 1 to 1000 Microinches

Completely portable, transistorized and battery-powered, the Model MS 1000 Surfindicator makes measurements from one to 1000 microinches of the surface finishes of metals, plastics, ceramics and organic materials. Moving over the test surface at a rate of ⅛ ips, the sapphire-tipped stylus detects variations of ½ microinch within the measurement range and it transmits deflec-

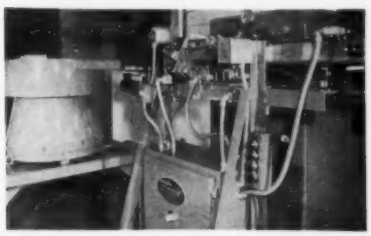
tions through a viscous fluid coupler to the current generator inside the pickup.

Minimum diameters of curved surfaces that can be checked without using a skid holder are ⅛ inch for outside diameters and, for inside diameters, 5/16 inch. Surface deviation from a mean line—computed either by arithmetical average or root mean square methods—is read directly from a meter. If desired, a profile can be obtained by connecting the instrument output to a direct writing record. Included with the unit is a calibration block with 125 and 20 microinch roughness patches.

Brush Instruments, 37th and Perkins, Cleveland 14, Ohio. **Circle 418**

## Plastic Preform Handler Automates Preheating

Integrated with Thermex preheaters, this all-electric device makes possible completely automated dielectric preheating of plastic preforms to molding temperatures. It indexes and loads preforms, controls the preheat cycle and delivers the heated material to the transfer pots of the molding presses. The cycle can be completed in no longer than 18 sec. Because the delivery of the



parts to the transfer pots takes less than 3 sec, heat retention is maximized and precuring is minimized. Preforms of any rectangular size and shape up to 3 x 4 x 1½ inches can be processed. If the usual alternate spacing loading arrangement is used, six preforms can be handled in one cycle. Without alternate spacing, its capacity is 12 preforms.

Girdler Process Equipment Div., Chemetron Corp., Louisville, Ky. **Circle 419**

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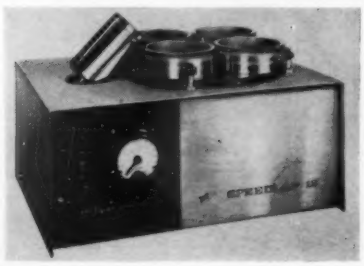
## Lapping Machine Produces Fine Surface Finishes

With its four 4½-inch ID rings, the Speedlap 12-inch lapping machine eliminates much pregrinding and provides 49 percent greater lapping area than a former model which had a larger piece capacity. It is constructed of stainless steel to prevent contamination and has a reversible lap plate, serrated on one side and solid on the other. The abrasive compound is applied automatically. The machine produces flatness to



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0.000003 inch with surface finishes of 2 μ in. and ±0.000050 inch parallelism.

Speedlap Corp., 3636 W. Oakton St., Skokie, Ill. **Circle 420**

## Proximity Limit Switch Needs No Contact

This proximity limit switch is designed to detect metal objects without physical contact. It senses nonferrous materials at distances to ½ inch and ferrous materials at distances to 1 inch. The all-transistorized circuitry is self-contained in the operating head of the CR115 D switch. Encapsulation protects the internal components from coolants or contaminants and allows use under water. Maximum repetitive accuracy is 0.005 inch; maximum differential, 0.01 inch; and operating time, 20 milliseconds. The switch will operate in ambients up to 150 F.

General Electric, Schenectady 5, N. Y. **Circle 421**

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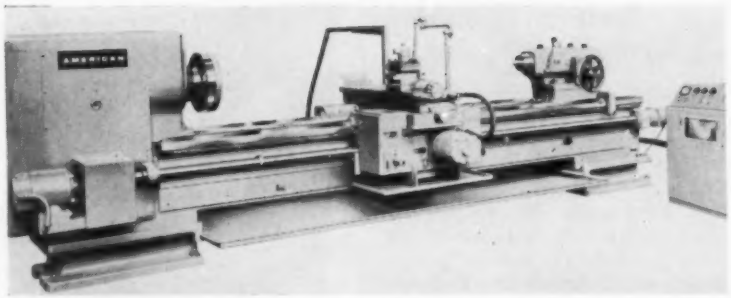

## Lathe Has Continuous Path Tape Control

This lathe, controlled by a General Electric Mark Century continuous path control system, using 1-inch, 8-channel punched tape, handles all roughing and finishing work on any turning, boring and facing operation. Four models are available. The 2010 and 2413 models have a total speed range of 25 to 1800 rpm and maximum motor size of 30 hp. Swing over the carriage wings for Model 2010 is 21 inches and swing over the carriage bridge and tool block is 10 inches. These measurements for Model 2413 are 24 and 13 inches.

The speed range of Models 2514 and 3019 is 16½ to 1200 rpm and the maximum motor size is 50 hp. The 2514 swings 25½ inches over the wings and 14 inches over the bridge and tool block. The 3019 has 31 inches of swing over the wings and swing over the bridge and tool block is 19 inches. All four models have two-speed heads, 16:1 motors and 30 taped changes.

Double electric clutches operating in conjunction with variable speed motors provide 20 cross feed rates and 20 longitudinal feed rates plus power rapid traverse to the cross slide and carriage. The extra long carriage bridge and cross feed screw give 16 inches of travel to the tool slide on the 2010 and 2413 models and 20 inches of travel on the 2514 and 3019 models. The square, tape controlled, four-way turret is mounted by curvic coupling.

American Tool Works Co., Pearl and Eggleston Ave., Cincinnati 2, Ohio. **Circle 422**


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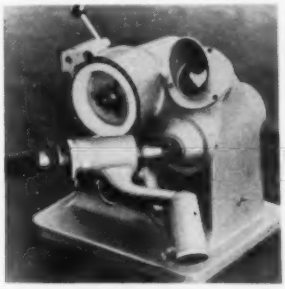
## Twist Drill Grinder Has Optical Inspection

Designed for sharpening small twist drills, this Tatar bench type grinder machine holds the drills in a quill equipped with a self-centering chuck or



collet. After checking the drill, the quill is axially moved until the drill point locates the stop. The image of the drill point appears, magnified 10 or 20 times, on the large screen where a number of orientation lines permit instant positioning. The quill can be positively indexed 180 deg for subsequent grinding of the opposite cutting edge.

The swivel arm has adjustable stops for setting the desired point and clearance angles. Thus, in one double sweeping motion back and forth across the face of the cup grinding wheel, all four facets are positively ground. A built-in gage for checking both lip lengths as-

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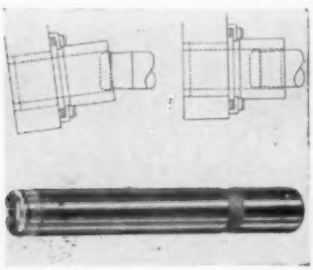
sures concentricity of the drill point. The machine can handle straight shank drills having diameters from 0.0135 to 1 9/32 inch.

Eric R. Bachmann Co., Inc., 27-11 41st Ave., Long Island City 1, N. Y. **Circle 423**

## Pilot Guide Post Assures Alignment

Extra ease in assembling and disassembling die sets is provided by this guidepost. It has a relieved pilot section



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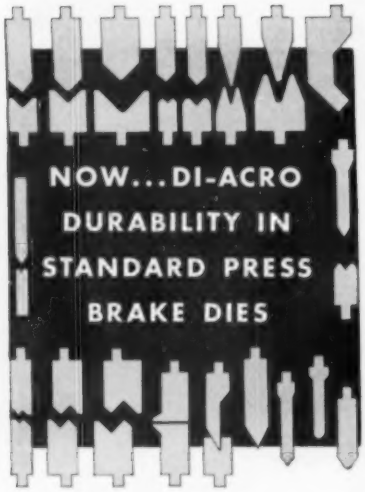


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Di-Acro standard v-type press brake dies are engineered for accuracy and dependability—in all press brakes. They are produced of heat treated alloy die steel for tensile strength and uniform hardness throughout. You can depend on longer lasting service. Choose from dies 6" to 12 ft. in length. Immediate delivery is available on most stock sizes. Next time you need dies . . . look to Di-Acro for the finest. Special dies will be quoted on request. Just send your sketches or drawings to our Engineering Service Department.

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Our die forms materials to $\frac{3}{4}$" thick—all angles to 60°. Hardened and precision ground rolls pivot smoothly to fold material gently—without work marks. You save time and reduce die costs.

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Form 13 different radii—0 to $\frac{3}{8}$"—just by changing the radius insert. Reduce set-up time and die costs. Heat treated alloy steel die with ground and polished inserts.

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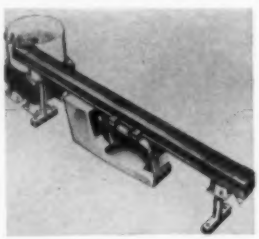
## TOOLS of today

just below a narrow band at the top of the post. As the punch holder is placed in position, the bushing hesitates on the pilot section and, with a pivot action, the bushing comes into alignment with the post. Alignment is possible even when the punch holder is not placed squarely on the post.

Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill. **Circle 424**

### Drive Unit Moves Small Parts

Directional vibratory movement can be applied to a cushioned trough, track or responsive surface, level or inclined, with the Vibra-Drive unit, which is especially suited for operation with processing and assembly machines. Small and minute parts can be handled with the unit. The drive units are electromagnetic vibratory motors operating from rectified 60-cycle a-c current, producing 3600 vibrations per minute. The power, or amplitude of vibration, can be regulated from high to low by turning a rheostat knob.



Syntron Co., 340 Lexington Ave., Homer City, Pa. **Circle 425**

### Foot Switches Control Machine Cycles

Two forms, the ratchet and reverse sequence, have been added to a line of cast-iron, snap-action foot switches for applications requiring foot operation of a cycle. The CR150 A8 ratchet form is designed to meet requirements where maintained control is needed. The contact mechanism consists of a snap-action switch with one open and one closed contact. As the foot pedal is depressed the contents are actuated—the open contact closes and the closed contact opens—and remain in this position un-

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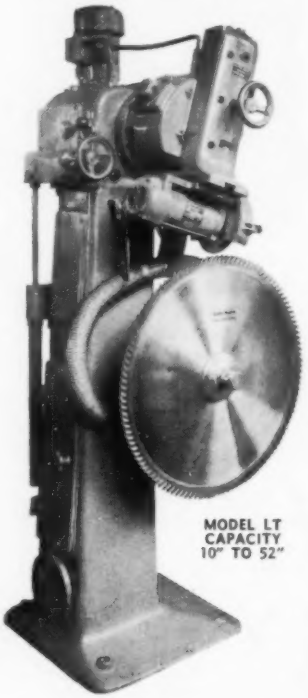
**WAGNER AUTOMATIC SAW BLADE SHARPENER**




**Produces correct tooth forms automatically and accurately without the use of costly index plates.**

Geared indexing and cam controls permit formation of any standard tooth style or pitch. Grinding of lands, chamfers and height difference is simple, fast, and accurate. All belts and pulleys are eliminated through independent motors. Grinding head has rotary adjustment for rake angles from 0° to 30°. The ideal companion machine to any of the 48 models of WAGNER cold saws.

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til the foot pedal is depressed again.

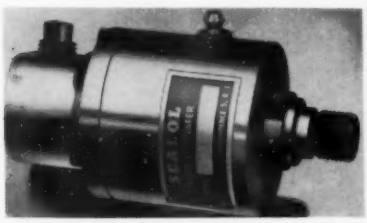
The CR150 A7 reverse sequence, two-stage foot switch has two snap-action switches each, one open and one closed contact. When the foot pedal is depressed, the contacts of one switch will operate before the contacts of the second switch. Upon release of the pedal, the contacts in the switch that operated first when the pedal was depressed will again operate first.

General Electric Co., Schenectady 5, N. Y. **Circle 426**

## Fluid Transfer Unit for Gun Drilling

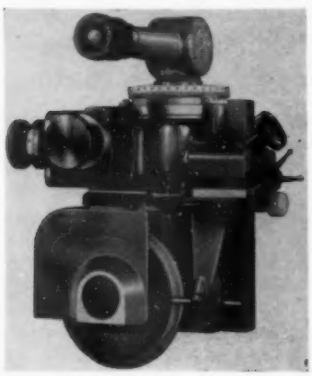
This fluid transfer unit will withstand cycling or steady pressures to 1200 psi at rotational speeds to 12,000 rpm. Applications include gun drills, clutches, power cylinders and similar uses calling for transferring fluids from a stationary source to a rotating hollow spindle.

Sealol, Inc., Providence, R. I. **Circle 427**



## Optical Attachment Dresses Wheels

Fast, precise dressing of wheels is possible with the Optidress, an attachment that can be mounted to practically any standard surface or tool and cutter grinding machine. It eliminates the need for templates and requires no set-up between grinding and redressing, since it remains on the machine. The unit has a built-in 10X microscope with a radius reticle and a 6-min. vernier

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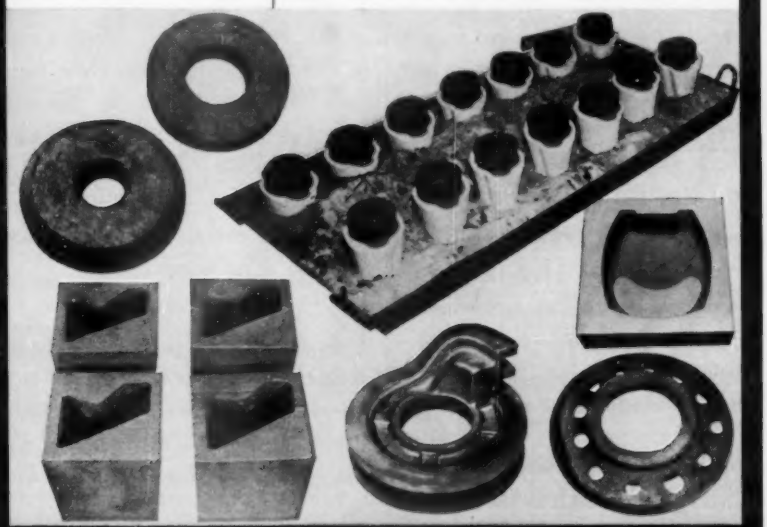

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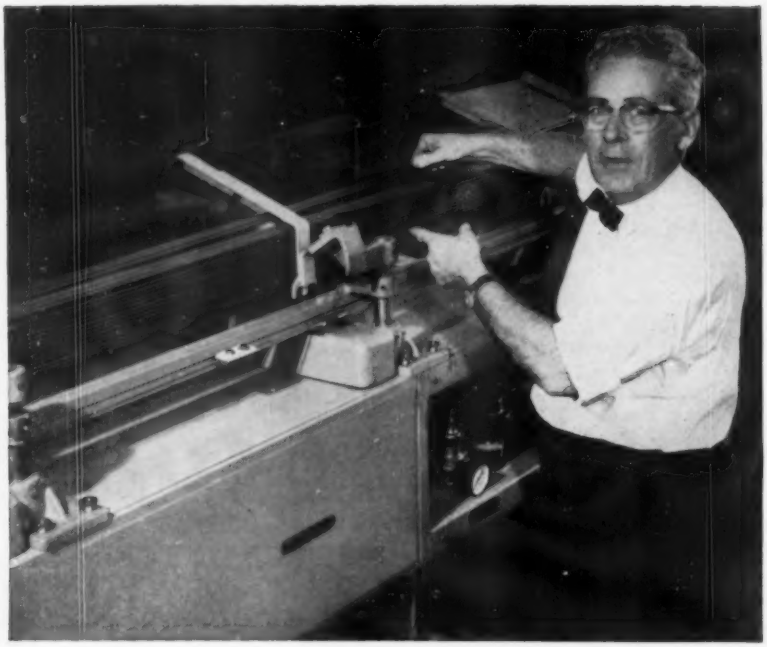

**How to get the most out of the money you didn't spend for a new production machine!**

What's the top gross geared capacity ever developed on the old machine, **in its very best days**...55%?...60%?...65%?

**LIPE A.M.L. Bar Feed Helps You Get Up to 90% of G.G.C. —on Old OR New Machines!**

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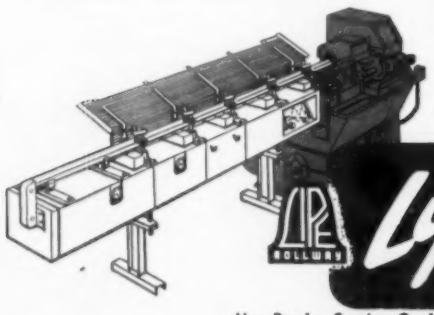
For complete information and name of distributor nearest you, write the company.



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Syracuse, N. Y.

Lipe BAR FEEDS

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for accurately setting the diamond. Radius and two tangent angles can be dressed in a continuous motion in a matter of minutes. Micrometer cross slides are provided to permit the dressing of any combination of radii and angles into on intricate form on the wheel. Optical control eliminates cut and try methods and assures a perfect blend between radii and angles.

The Parker-Hartford Corp., 650 Franklin Ave., Hartford, Conn. **Circle 428**

## High Speed Unit Gages, Sorts

Manual gaging and sorting of dice, pellets or wafers for semiconductors can be eliminated with the TSK Auto-Sorter. This unit automatically gages germanium or silicon pellets and sorts them into proper categories at a rate

of 2400 per hour. It is possible to sort into any one of 10 categories with consistent repetitive accuracy to within 0.000040 inch. Digital counters count each preset catagory. The unit can be set to stop automatically after the pellet supply runs out or after a given number of rejects is reached.

D. M. Gaskill & Associates, Inc., 342 Budlong Rd., Cranston 10, R. I. **Circle 429**

## Welding Clamp Has Any-Position Mounting

Especially useful when welding rounds to flats, this C-clamp is of solid beryllium copper, which eliminates the need for special coatings and protective shields. Spatter will not stock to the spindle or to the body of the clamp. The clamp is quick-closing and opening and has a threadless spindle that eliminates frame twisting when tightened. The clamp is available with V-spindles and is available in 2-inch,

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**MODEL D-2 HEAVY-DUTY 2-DIMENSIONAL**

**Pantograph for milling, drilling and engraving.**

Vertical adjustment of copy table automatic with Pantograph. Features: unobstructed on 3 sides to take large work; micrometer adjustment for depth of cut; ball bearing construction throughout; spindle speeds up to 26,000 rpm for engraving or machining; vertical range over 10", ratios 2 to 1 to infinity — master copy area 26" x 10"

**NEW**

**MODEL D2-201 PNEUMATIC ATTACHMENT**

for use with Model D2 Pantograph Engraver to rapidly drill holes in printed circuits by tracing templates. Drills as many as 100 holes per minute. Equipped with foot switch; spindle, air cylinder; regulating valve and pressure gauge; filter and oiler. It's ready to use as soon as it's attached to an air compressor.

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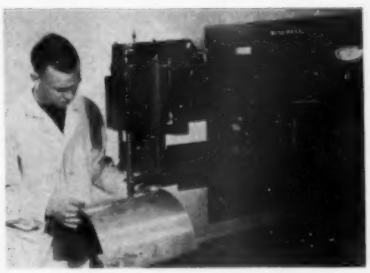
4-inch and 6-inch standard frame sizes and 4 by 4-inch and 6 by 6-inch deep throat sizes.

United Associates, 1605 N. Hercules, Clearwater, Fla. **Circle 430**

## Ultrasonic Spotwelder Has High Capacity

Field experience has been utilized in designing a 4000-watt capacity ultrasonic spotwelding machine. The model W-4000 FSR has 36-inch throat depth. In addition to welding conventional metals, the machine can be used



to join refractory metals such as molybdenum, niobium, tantalum and tungsten, because it is inherently a solid-state process that does not rely on melting the metals being joined.

Sonobond Corp., 310 E. Rosedale Ave., West Chester, Pa. **Circle 431**

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## Hydrogen Furnace Heat-Treats, Brazes Steels

Bright heat-treating the aircraft and missile steels and stainless steel and brazing stainless steels can be done with this full muffle hydrogen atmosphere furnace. Capable of temperatures to 2100 F, the unit is electrically heated and has an accelerated atmosphere quench. One feature is its horizontal cylindrical muffle with complete atmosphere lock ahead of the cooling section. It also has a heat exchanger built into the quench chamber. Snake-chain mechanisms for loading and un-


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*Strength in one or more of the following fields: subminiature transformer and toroid production, plastic and rubber formulation and fabrication, sheet metal fabrication, heavy and small parts machining, and fabrication and assembly of precise and delicate electrical and electronic assemblies requiring special environmental facilities.

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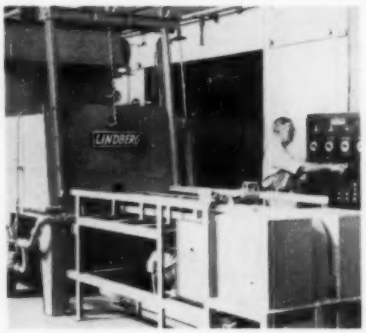


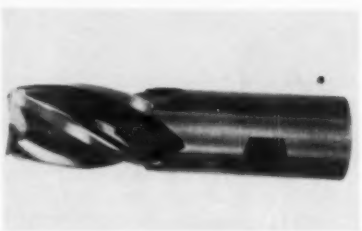
loading the charge from the heating and cooling chambers minimize vibration.

Lindberg Engineering Co., 2444 W. Hubbard St., Chicago 12, Ill. **Circle 432**

### Carbide End Mill Withstands Shock

Intended for the machining of high-alloy steel, this end mill is made with a special grade of carbide to withstand shock. It is ground to a super finished edge with negative rake. Sizes are 1/32-inch diam to 3/4-inch diam.

Starlite Industries, Inc., 58th and Market Sts., Philadelphia 39, Pa. **Circle 433**



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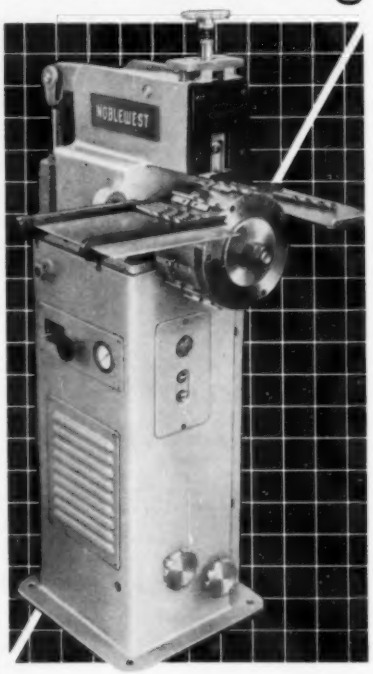
### High Production Slitter-Winder

Designed for slitting and winding paper, plastic film, and ferrous and nonferrous metals, this slitter-winder has tamper-proof adjustments. It is equipped with a low-pressure air-operated sensing head that can be set and locked, according to the width of the web. A magnetic proportioning brake, with bayonet lock and self-aligning pin, completely eliminates bind caused by maladjustment. An electrical trimmer adjusts the stopping of the brake, holding the web edges in alignment regardless of web speed. A turret rewinder for continuous rewinding without stopping


# high speed metal marking



*precision marks up to 10,000 per hour*

For marking drills, rods, and similar shaped work pieces, this Series 19 Model 562 Vertical Dial Roll Marking Machine is unsurpassed for capacity, ease of operation, quality, of marking. Marks *permanently* indented impressions. Features include air loaded marking head, and universal carrier dial to accommodate parts from 1/16" to 1/2" diameter. Other models for every marking requirement. Write for literature.

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**16 Westbrook St., East Hartford 8, Conn.**

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**MARK-O-RAMA**
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*Tool Exposition*

*mark it best with*
**NOBLEWEST**
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the machine can be provided. Sizes that can accommodate 16, 20, 24, 30, 36, 48, 60 and 72-inch widths are available.

Web Controls Corp., 318 Briarcliffe Rd., West Englewood, N. J. **Circle 434**

## Marking Machine Is All-Pneumatic

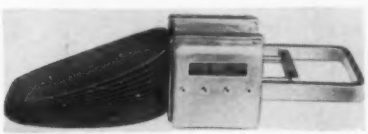
The Model 574 general purpose marking machine is all-pneumatic in operation. The operating mechanism is contained in a compact head, which is comparable to an air or hydraulic press and supplies both the marking pressure and horizontal die slide travel for roll

marking. Air pressure controls depth of mark and insures uniformity of impression depth in each marked piece regardless of variations in work thickness. Specifications are: height, 58 inches; width, 11¼ inches; depth, 15¾ inches; weight, 200 lb; vertical handwheel adjustment, 3⅜ inches; vertical air stroke, ½ inch; die slide stroke, 3½ inches; gap (underside of die table), 8¾ inches; reach (column to center ram), 3⁷⁄₁₆ inches; table size, 6 by 8½ inches.

Noble & Westbrook Manufacturing Co., East Hartford, Conn. **Circle 435**

## Magnetic Lifter Simplifies Parts Feeding

This manually operated magnetic unit for handling small or large metal parts can also be used for feeding round, square or irregularly shaped sheets into presses, shears and similar production equipment. Suitable for small parts packing, sorting and weighing operations, it picks up and securely holds a quantity of loose nuts, bolts, screws or other light metal objects. A squeeze on the plunger-like handle instantly releases the parts. Heavier items such as blocks, dies, rods, etc., are handled with equal facility and a positive grip is assured even on wet, greasy, sharp or hot metal objects.



The device separates stacked metal sheets and is adjustable to accommodate various weights and thicknesses. Pry marks and scratches on parts are eliminated, and hazard of injury to workers is reduced. Optional stainless steel strips offer extra protection against wear. Two models are available—one handles up to 3 lb of loose parts or larger pieces to 30 lb and the other has a 5 to 50-lb capacity. For sheet separation, the two units will handle maximum thicknesses of 16 and 11 gage.

Jess Corp., 15770 Telegraph Rd., Detroit 39, Mich. **Circle 436**

## Control System Samples, Interprets Data

Quality control, industrial process study and process optimization—which require frequent sampling and interpretation of data—are three applications of the 1710 multipurpose industrial control system. When used as a control

**For** { 8-STATION PRODUCTION MACHINING
1½" BAR AND COLLET WORK
CHUCKING
SINGLE POINT THREADING

**Costs** { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

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3R-TURRET LATHE

*Write for bulletin with complete specifications and tooling data*

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Builders of 10", 11", 13", 15" Sheldon lathes, Sheldon Milling Machines, Sheldon Shapers and Sebastian Geared Head Lathes

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system, it can scan up to 3000 instruments at regularly timed intervals and provide instructions for the adjustment of control settings. It can also perform the calculations necessary to build a mathematical model.

In manufacturing quality control, the system can be used in analysis and recording of the final test of such diverse items as transistors and refrigerators as they come off an assembly line. Every unit is automatically inspected, replacing random checks. In addition, the computer evaluates the units, or groups of units, and indicates where modification of manufacturing steps may be necessary to eliminate flaws.

The system is composed of a data converter and a solid-state data processing system. The computer can be used independently of the control system to perform engineering processing jobs.

International Business Machines Corp., 112 E. Post Rd., White Plains, N.Y. **Circle 437**

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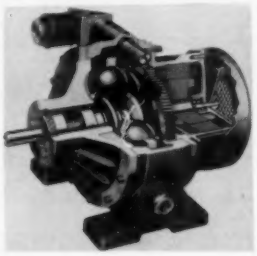
## Variable Speed Drive Has Pancake Motor

Exceptional compactness has resulted from incorporating an integral pancake style motor with a mechanical variable speed drive. The motorized speed variator occupies only slightly more space than an equally rated conventional motor. The line is available in sizes from ⅓ to 15 hp. Motors are a-c radial air gap design and conform to NEMA design "B" specifications. The unit gives variable output speeds with 9:1 and 6:1 ranges.

Power is transmitted through an input shaft to a beveled drive disk that is in contact with axle-mounted alloy steel drive balls. Input shaft rotation causes the balls to rotate about their axles, which in turn transmits power

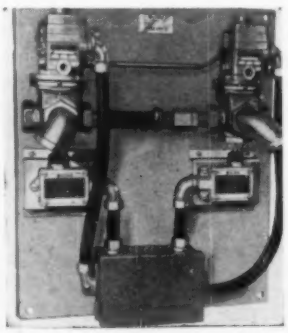


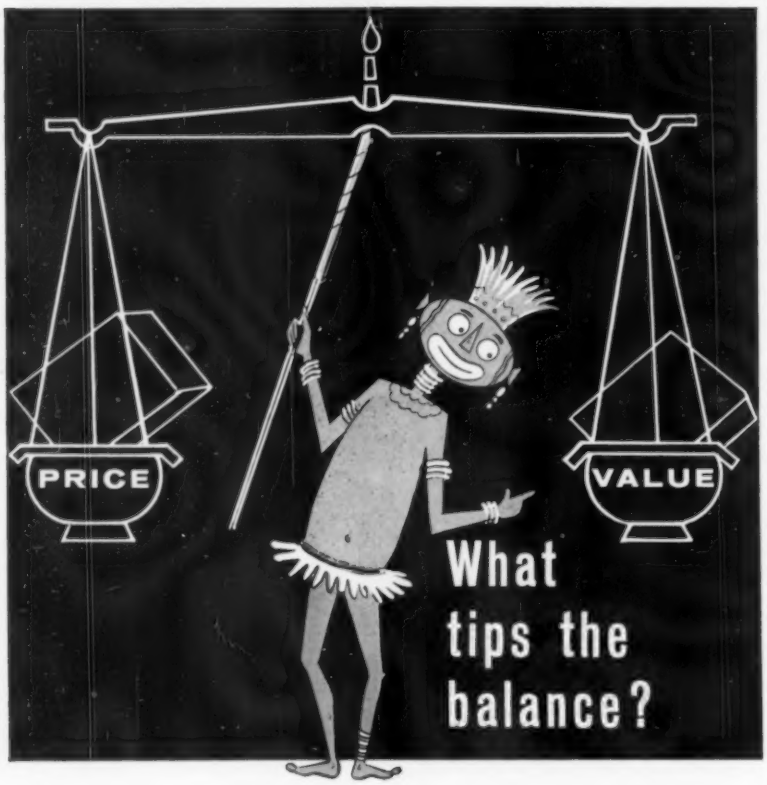
to the output shaft by a similar ball-disk contact. Output speed is determined by relative lengths of the contact paths on input and output sides of the balls. By tilting both axles and balls, relative lengths of the two contact paths are varied to give increasing or decreasing ratios.

Cleveland Worm & Gear Div., Eaton Mfg. Co., 3300 E. 80th St., Cleveland 4, Ohio. **Circle 438**

## Dual Valve Assembly Protects Clutches

Electrically interlocked protection for air-actuated clutches is offered by this dual valve assembly. An integral part of the clutch-control circuit, the assembly is designed so that, if one valve remains open when de-energized, the other valve






*Our customers know that buying on quality pays off!* They've weighed the price (sometimes a few cents more) against WHAT REALLY COUNTS. They've found cost-per-piece of drilled parts consistently lower and upkeep expense invariably less with U.S. multiple spindle heads. They've found that quality materials and workmanship back up sound design in every U.S. head. Unrealistic pricing and price cutting can lead only to product degeneration. Our customers know that **buying on quality pays off.** They've proved it many times!

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Adjustable and Fixed Center Multiple Drilling Heads — Individual Lead Screw Multiple Tapping Heads — and Fixtures.

**UNITED STATES DRILL HEAD COMPANY**
**5298 River Road • Cincinnati 33, Ohio**

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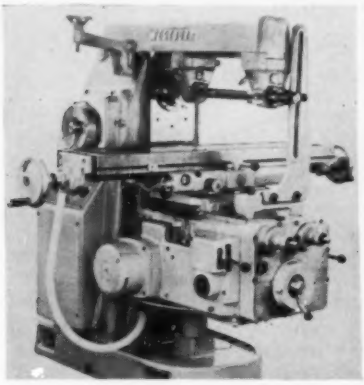
will close and stop the machine. Before another stroke or cycle can be started, the defective valve must be repaired or replaced. The assembly meets JIC specifications and includes two 3-way valves connected in series, two limit switches actuated by the poppet extension of the valves and a wiring enclosure housing the terminal strip. It is available with ⅜ and ¾-inch valves and in 115, 230 or 460-volt, 60-cycle, a-c.

Minneapolis-Honeywell Regulator Co., Freeport, Ill. **Circle 439**

## Milling Machine Line Is Redesigned

The Hermes line of milling machines now has independent motors for speeds and feeds and dial type speed and feed selection. An electromagnetic clutch with brake on the spindle is controlled by pushbuttons from the front of the machine. Other features include power feeds and rapid traverse in all direc-



tions; a climb milling attachment; force feed lubrication by pump in speed gear box; and one-shot lubrication for feed gear box, knee table and saddle. The electric controls are in a panel on the side of the machine. These millers are available in two sizes having table sizes of 55 x 11 inches and 63 x 13¾ inches and a longitudinal travel of 37 and 45 inches. Total horsepower is 5½ and 7½, respectively.

Hermes Machine Tool Co., Inc., 48-15 Northern Blvd., Long Island City 1, N. Y. **Circle 440**

## Milling Vise Has Compensating Jaws

Illustrated is the Gang-Vise tooled for straddle milling ten ⅜-inch-diam shoulder pieces in 25 sec. The vise has a compensation jaw assembly which assures even pressure on a multiple number of pieces varying in size. These pins can be removed and ground to hold special shapes or can be replaced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Low-cost volume forming of conduit elbows by the Kaiser Aluminum & Chemical Corporation at their Dolton, Illinois, plant has been important to their attainment of a leading position in the production of aluminum electrical conduit. Conduit and elbows are produced in 13 standard sizes ranging from ½" to 6" I.P.S. A single, versatile Pines Model 3 Bending Machine handles the ten standard conduit sizes from ½" to 4" . . . producing smooth 90° elbows with speed and accuracy.

The conduit elbows are bent without the use of mandrels, keeping tool costs low. Even without mandrels, there is no distortion of prethreaded ends and flattening is held well within the limits set up by the Underwriters Laboratories Code. Production of smaller size elbows is increased up to 75% by bending two at a time on stacked tools.

Find out now how the speed and versatility of Pines Bending Machines can help you produce better quality products that cost less.

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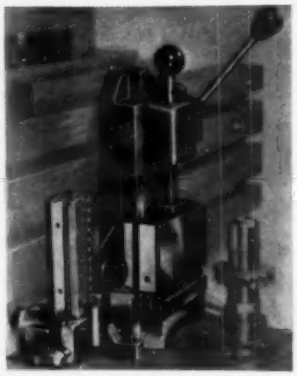
## TOOLS of today



with other jaws fitted for special jobs. Various jaws are available which allow holding as many as sixteen ¼-inch-diam pieces or four 1-inch-diam pieces.

Lassy Tool Co., Plainville, Conn. **Circle 441**

### Pneumatic Valve Is Dual-Purpose

Operating on a pressure differential, the Modernair 2-in-1 valve is completely self-contained. Used as a quick-exhaust valve, it can be mounted on or near the cylinder port. The moment pressure from the control valve is released, the valve dumps exhaust air from the cylinder directly to the atmosphere, eliminating line friction and control valve restriction. As a double check or shuttle valve, the 2-in-1 can be used to connect two independent air supply or control lines to a common line. It is suited for two-station control, interlocking, and

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"or" circuitry. The valve, which has an aluminum body, operates at pressure to 200 psi, is 1¾ inches in diameter and 2½ inches long, with three ⅜-inch NPT female ports. The only moving part is a Neoprene diaphragm.

Modernair Corp., 400 Preda St., San Leandro, Calif. **Circle 442**

### Grinding Wheel Dresser Has Adjustable Control

With this control mechanism, adjustments for diamond point wear in split-tenths—0.0001 inch and finer—are possible without loosening or tightening any screws. In grinding wheel dressing, the adjusting control eliminates hand trial-and-error methods while maintaining required wheel size. Built

into the grinding wheel dresser arm, the mechanism is connected directly to the diamond holder. Turning a calibrated knob the required distance adjusts the diamond point accordingly. The unit is sealed against coolant and foreign particle infiltration.

Briney Mfg. Co., Box 208, Pontiac, Mich. **Circle 443**

## Angle Beam Transducers Detect Hidden Flaws

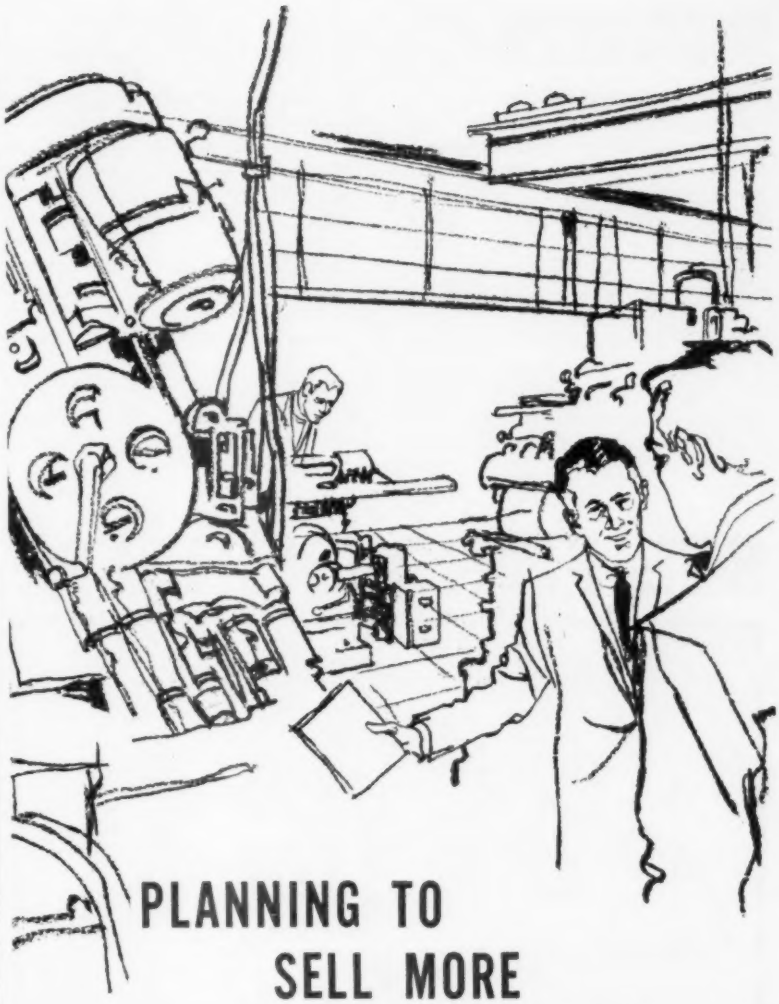
Designed primarily for the Sonoray ultrasonic flaw detector, these angle-beam transducers find hidden flaws—

voids, porosities and discontinuities—in metals and other hard materials. The three types available offer various wedge angles, transducer sizes and operating frequencies. All have Type Z crystals, a Lucite wedge and a cable with a quick-disconnect fitting. With interchangeable transducer and wedge components, Type ZSL operates at frequencies of 1, 2.25 and 5 megacycles and its wedges produce angles from 45 to 90 deg. Type ZSN generates one type of wave at one angle. The third type, ZSM, measuring ¼ x ¼ inch in the crystal cross section, is a fingertip model.

Branson Instruments, Inc., 40 Brown House Rd., Stamford, Conn. **Circle 444**

## Instrument Monitors Machines, Processes

Amplitudes and frequencies of signals obtained by pickup devices attached to machines or processes are translated into normal and off-normal indications by Series 18 operation monitors. Panel lamps indicate, and external relays operate, at varying degrees of change from desired operating conditions. Internal logic elements con-

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vert selected combinations of these limit signals into normal, alert and alarm relay action. The instruments have a capacity of two data channels, each with two limit levels. These channels can be excited by two separate transducers, or they can be used to monitor two characteristics of a signal from a single pickup.

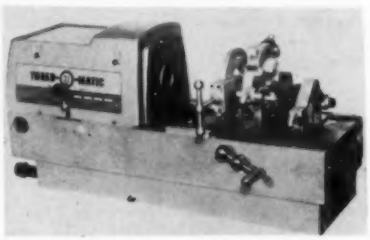
The signal levels or frequencies are presented on panel meters that can be calibrated in units of vibration displacement, velocity, acceleration, g's, strain, peak strain, pressure, peak pressure, optical reflectivity and sound levels or frequencies.

This new application of signal spectrum monitoring provides an immediate and highly sensitive notification of changes in machine performance and process adjustment. The instruments are applicable to any machine or process in which off-normal conditions can be described in terms of a change in frequency or amplitude of signals developed during normal operations. Applications include machine tool vibrations, bearing and balance conditions in turbines, pumps or compressors, material homogeneity inspection, mixing end point, fluid flow turbulence or cavitation, and acoustic process monitoring.

RayData Corp., Columbus, Ohio. **Circle 445**

## Threading Machine Cuts, Reams

Because it has a power-operated, automatic double chuck, the Thred-O-Matic 22-A machine eliminates flywheel type or spin chucks, rear centering guides and check wrenches. Available with single, double or universal dieheads with built-in oil flow, the machine has a cutter on the carriage for maximum visibility and accuracy in cutting.



The position of the cutter and reamer assemblies is interchangeable. The machine's range is from ⅛ to 2 inches in pipe and conduit and, in bolt, ¼ to 2 inches. A ½-hp, six-brush motor develops 3½ hp at the chuck.

Collins Machinery Corp., 955 Monterey Pass Rd., Monterey Park, Calif. **Circle 446**

## Fractional Horsepower Motors Have Many Uses

These totally enclosed, nonventilated, three-phase, Form G fractional horsepower motors are rated from ¼ to ¾ hp at 220/440, 220/380 and 550 volts. The ¼-hp models are in NEMA frame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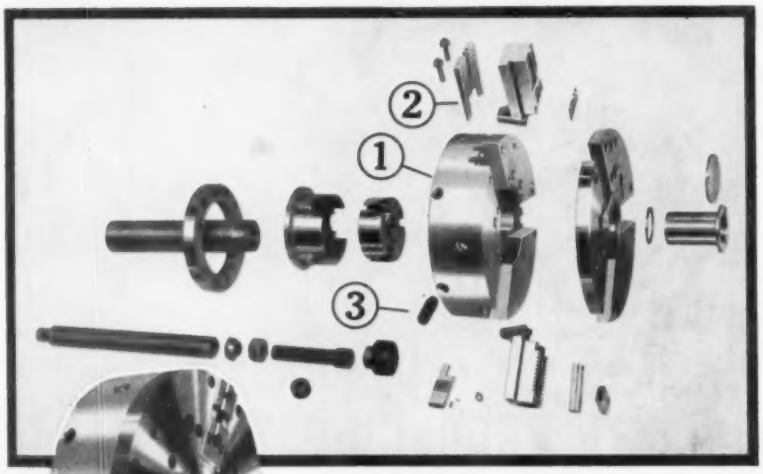

Buck Ajust-Tru®
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Aluminum Body
POWER CHUCK

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This photograph shows you three of the reasons for the unusual production records of Buck power chucks.

(1) *Aluminum Body.* This, plus new design jaws, saves 40% in weight. Lighter masters have less centrifugal force—grip better at high spindle speeds. All parts but body are steel.

(2) *Gibs on Keyways.* Can be quickly tightened to preserve original accuracy. Should easily *triple* the useful *precision life* of the chuck.

(3) *Buck Ajust-Tru Screw.* One of the screws to adjust chuck (with work gripped at full pressure) to guarantee precision within .001".

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Makers of Scroll, Power, Dust Proof, Independent Chucks.

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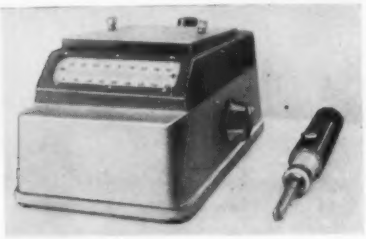
sizes 48 and 56; all other models are NEMA frame size 56. Features include continuous duty operation at 55 C temperature rise; a large built-in connection box and resistance to lint, rust, corrosion, shock and vibration.

General Electric Co., Schenectady 5, N. Y. **Circle 447**

## Thermoelectric Probe for Nondestructive Tests

This instrument consisting of a thermoelectric probe and a meter is used to nondestructively test metals, alloys and nonmagnetic or magnetic metallic coatings. The Model TE-1 probe detects differences by means of thermoelectric power. For example, metal bars of sheets which look alike can be sepa-

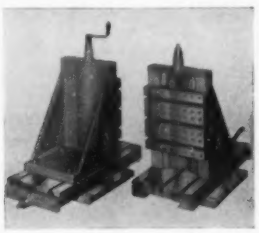


rated by contacting two points of the metal and noting the thermoelectric power. The instrument is useful for incoming inspection, metal storerooms or machine shops.

Electro Impulse Laboratory, Inc., 208 River St., Red Bank, N. J. **Circle 448**

## Universal Fixture for Boring Machines

This universal fixture for precision boring machines is a combination of two units. Four T-bolts permit instant removal of the vertical angle plate feed to permit independent use on other machines, or for fixturing and bench work.



The vertical feed platen has both T-slots and tapped holes to securely hold either the tool or the work. Hand and hydraulic feed models are available. Each slide is 12 inches wide. The angle

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M-60

Wheel Diameter 6"

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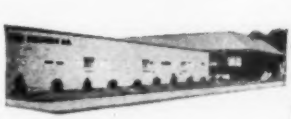

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5
625
6

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# For precision work to .0002"

The new VERNAC direct reading optical measuring instrument indicates longitudinal, lateral or vertical position of the table of any machine tool without benefit of mechanical connections. It can be incorporated in new equipment or tools already in service.

**HOW IT OPERATES:** Readings from a precision scale, affixed to the machine tool table, are transmitted through a 22-power lens system onto an illuminated, highly visible, direct-reading dial. Readings are in .025" intervals. A double spiral reticle on the dial provides further measurement refinement to .0001". All readings are complete within the dial area eliminating reference to an outside pointer.

*The scale is a replica of a master certified by the U.S. National Bureau of Standards to .0001" maximum error over its entire length.

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- All readings on one dial
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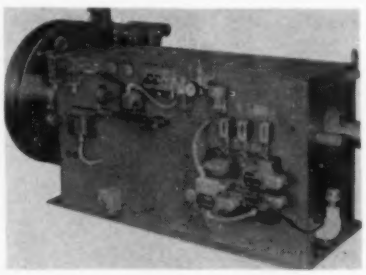
## TOOLS of today

plate has 7-inch travel and a 12 by 14½-inch mounting base. The horizontal slide has 12-inch travel, a 16 by 16-inch mounting base and a 12 by 28-inch T-slotted platen.

Standard Electric Tool Co., 2499 River Rd., Cincinnati 4, Ohio. **Circle 449**

### Wire Take-Up Reel Has Variable Traverse

This hydraulic traversing take-up reel has an infinitely variable traverse lead, accommodating wire widths to ⅝ inch. It can be operated without the traversing feature for pancake winding of



tape, ribbon, or strip. Model 2310 consists of a floor-mounted housing containing the mechanism and a spindle whose standard flange will mount a collapsible drum or standard spool. All operating power, except for the pump, comes from the 3-inch-diam spindle, driven by either a belt or chain drive from existing equipment with a clutch inserted between the drive and spindle, or a separate a-c motor and reducer. When the clutch is used, constant torque winding results. When a d-c motor and regulator is used, constant tension winding results. The reel handles a maximum coil weight of 1000 lb. Maximum stock tension is 300 lb.

Fenn Mfg. Co., Newington, Conn. **Circle 450**

### Gage Measures Thickness of Fragile Materials

Designed to measure the thickness of thin, fragile materials such as those used in semiconductor wafers without gage point pressure, this Precisionaire noncontact thickness gage floats the part in air during gaging. As air flowing out of opposed jets calipers the part, the thickness is indicated by the position of the float in the column. One

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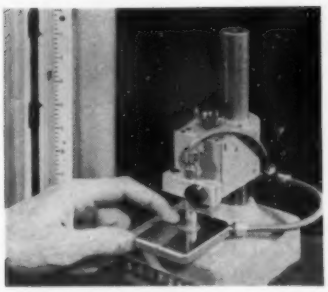


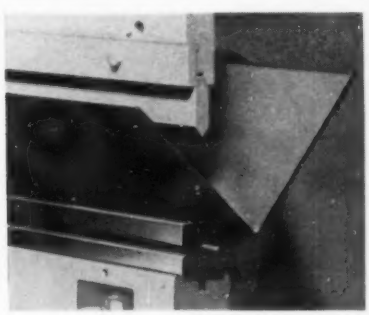
jet is in the head and the other in the anvil. The gage head is adjustable from 0.0001 to 4 inches. The first of the two models available has a foot pedal for turning the air on and off to facilitate loading the material into gaging position. The second has no foot pedal so that air flow is continuous. The gage, calibrated with minimum and maximum size parts, requires no masters.

Sheffield Corp., Dayton 1, Ohio. **Circle 451**

## Press Brake Dies Give Long Service

Unlike dies of surface-hardened carbon steel, Tufloy dies are uniformly strong all the way through. Used for bending and forming operations, the dies are of heat treated, stress relieved and machine straightened alloy steel. Because heat treatment of Tufloy dies before or after reworking is not required, they can be reworked without returning them to the factory.

Commonly used 90-deg and 30-deg air bend dies, flattening and offset dies, three and four-way dies, and 90-deg



gooseneck punches, are stocked in 2, 4, 6, 8, 10 and 12-foot lengths. The average die, with a working shut height of 5¼ inches, can be used with any standard press brake equipped with die holder and ram adjustment.

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y. **Circle 452**

## Tracer System Automates Relief Milling

Utilizing a milling head and a two-dimensional tracer control system, this setup provides automatic milling of reliefs on extrusion dies and, in some cases, milling of the actual die opening. The tracer system has four basic components—a rotating eccentric stylus assembly, a control panel, a control station and a power drive.

On contact with the template, which conforms to the design to be cut in the extrusion die, the stylus assembly continuously feeds electric signals to X and Y-axis servo drives. These low-powered signals are boosted to actuate a servo motor which controls table and cutting movements.

Any contour around a 360-deg path

can be followed at a constant cutting speed with an accuracy of ±0.003 inch. Tracing speed can be controlled over a 50 to 1 speed range and the eccentricity of the stylus can be varied so that the system automatically compensates for tool wear.

Seneca Falls Machine Co., Seneca Falls, N. Y. **Circle 453**

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## TOOLS of today

### Quick-Operating Fastener Is Miniaturized

Developed especially for miniaturized electronics applications, where space and weight limitations are important considerations, the Mini-Q-Lock locks or unlocks with one-quarter turn. No holes are required and no special tools are needed for installation. Minimum inside projection is less than 1/8 inch and, due to an extra-thin oval head, outside projection is also at a minimum.

Rose Industrial Products Corp., North Broadway, Albany, N. Y. **Circle 454**

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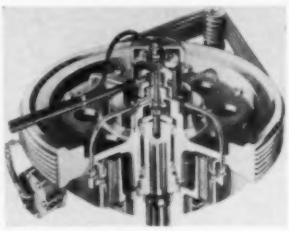
### Miniature Clutch, Brake Provides High Power

Designed for high-speed operation, the FSPA miniature pneumatic clutch and brake package for bench presses in the low-tonnage capacity range has a 6-inch-diam drum type air clutch and a 4-inch-diam self-energizing brake. The air-actuated clutch has a 360-deg friction surface, responds to pushbutton control and adjusts itself for wear. The

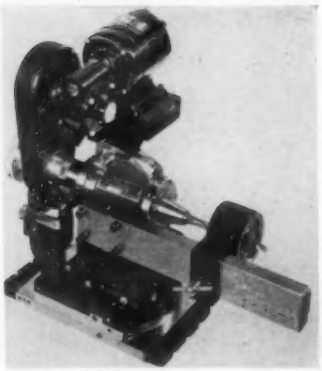


spring-engaged, air-released brake automatically engages in case of electrical or compressed air failure. The package eliminates backlash and protects tools and dies. The clutch portion of the package can be used in pulley-mounted applications.

Fawick Airflex Div., Fawick Corp., 9919 Clinton Rd., Cleveland 11, Ohio. **Circle 455**

### Center Support for Grinding Long Tools

This heavy-duty support bar is optional equipment on R-O universal form relief grinding equipment. It consists of a single bar with 2¼-square inch cross section and is intended to eliminate center deflection or distortion in grinding long tools. A full 6-inch swing is

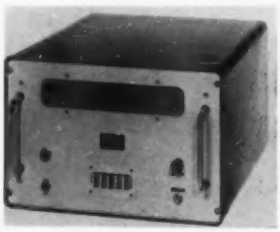


provided with the support so that large-diameter taps and other tools can be ground on the fixture.

R-O Manufacturing Co., 31171 Stephenson Hwy., Madison Heights, Mich. **Circle 456**

## High Speed Counters for Machine Tools

Suitable for use with lathes, drill presses, boring mills, surface grinders and optical comparators, Series 1805 electronic counters can register up to 5000 counts per second. They measure



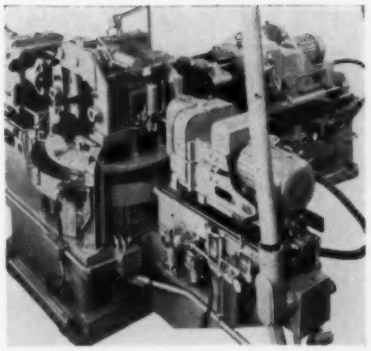
displacement, actuated by a rotary pulse generator type of transducer, in a bidirectional (add-and-subtract) manner. The actual displacement measured can be the axis of a basic machine tool. Standard size is 14 7/16 inches wide by 9 1/2 inches high by 16 3/4 inches deep. Two completely enclosed standard units are available for five-digit and six-digit readout.

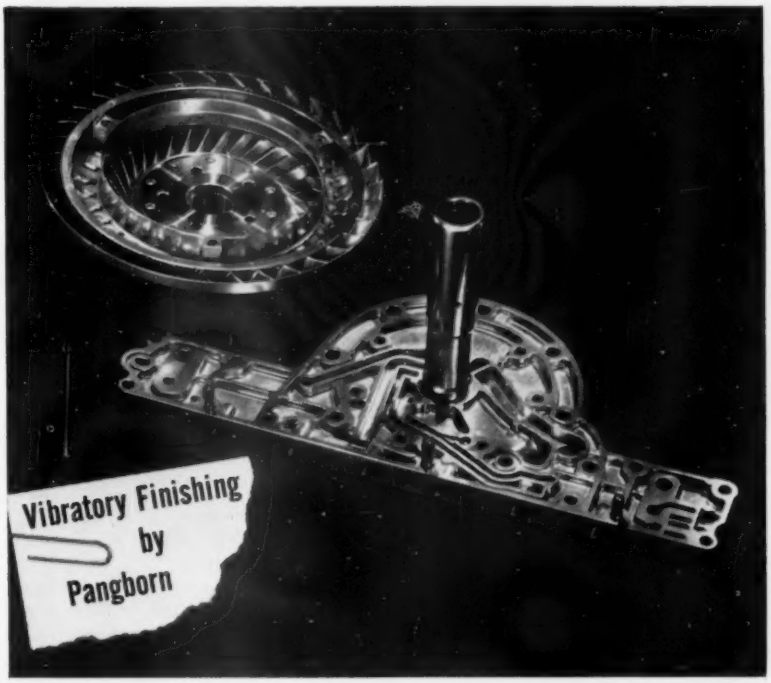
Electronic Controls Div., Veeder-Root Inc., Danvers, Mass. **Circle 457**

## Multiple Spindle Drill Has Indexing Table

This three-way, 11-spindle hydraulic feed machine for drilling and tapping large components such as cylinder blocks has a four-position power indexing table which rotates 360 deg to load, locate and unload parts. In operation, the part slides into the indexing fixture, which clamps and locates the part automatically. The fixture indexes 90 deg clockwise and locks to permit the left-hand head to rough bore and chamfer one 3/8-inch hole, simultaneously drilling and chamfering four 3/8-inch holes. After the part indexes another 90 deg, the back way-unit finish bores the first hole and drills one 0.438-inch hole. A third index of 90 deg brings the part to the right-hand way-unit, which taps the four 3/8-inch holes. A fourth index completes the rotation, and the part is released for unloading. Total cycle time is 1.77 minutes, which is equivalent to a production rate of 27 parts per hour at 80 percent efficiency.

Foote-Burt Co., Cleveland 8, Ohio. **Circle 458**




## Suddenly complex finishing has a simple solution!

The Pangborn Vibratory Finishing Machine has an unusually wide range of application. What would you like to descale, deburr, radius, finish or burnish?

Metal and metal alloy as well as many plastic and ceramic parts may be vibratory finished. This machine processes extremely small and delicate items with the same facility it handles large and heavy objects.

What's more, the Pangborn Vibratory Finishing Machine performs as much as 100 times faster than conventional equipment. Cuts costs? You bet!

All sizes of the machine come equipped with variable speeds and amplitudes plus new improved air-cushioned suspension. Optional air-cushioned floor mounts completely eliminate any transmission of vibration to the floor. Auxiliary equipment and the best in media and compounds are available for your every need. Send parts with exact finish specifications or finished specimen for sample processing in our laboratory to Mr. William E. Brandt at:

PANGBORN CORPORATION, 4700 Pangborn Blvd., Hagerstown, Md.; Pangborn Canada Ltd. 47 Shaft Rd., Toronto (Rexdale), Canada — *Manufacturers of Vibratory Finishing, Blast Cleaning, Dust Control Equipment — Rotoblast® Steel Shot and Grit®.*

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**Cost reduction in small parts production** is our business. Let us discuss the 16 areas in which V & O presses, press tooling, dial feeds, and special units can be of help. Just a few minutes going over the above Cost Reduction Planner with one of our men could lead to dramatic savings. Ask to see a representative by contacting Emhart Manufacturing Company, Hudson Division, Hudson, N. Y. It could be one of the most important requests you'll make this year.

**EMHART**

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**COST REDUCTION IN SMALL PARTS PRODUCTION**

Ten minutes with an Emhart rep may uncover a hot new cost reduction plan in one or more of these areas:

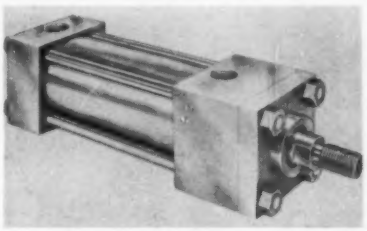
1 PRODUCT DESIGN
2 MATERIAL AND PARTS FLOW
3 PACKAGING
4 FABRICATION
5 ASSEMBLY
6 DIRECT LABOR
7 INDIRECT LABOR
8 METHODS SIMPLIFICATION (PEOPLE)
9 METHODS SIMPLIFICATION (MACHINES)
10 QUALITY CONTROL
11 IN-PROCESS INVENTORY
12 MAINTENANCE
13 FLOOR SPACE
14 SPARE PARTS INVENTORY (CUSTOMER)
15 SPARE PARTS INVENTORY (V & O MACHINES)
16 CRITICAL OPERATIONS

V & O AUTOMATIC PRESSES AND FEEDS

## TOOLS of today

### Air Cylinder Meets JIC Standards

The Series K air cylinder, rated at 200 psi, meets all JIC standards. The cylinder barrel is of cold-drawn brass and the piston rod is of high tensile



steel, with a minimum yield strength of 90,000 to 100,000 psi. Bore sizes are 1½ to 14 inches.

Ortman-Miller Machine Co., 19 143rd St., Hammond, Ind. **Circle 459**

### Hard Surfacing Electrode Joins Dissimilar Metals

Such dissimilar metals as austenitic manganese and carbon steel, austenitic manganese and T-1 steel, and stainless steels and carbon steels, can be joined with Hardalloy 120, a hard surfacing electrode. Controlled ferrite level of the electrode is 12 percent, providing crack resistance equal to armor welding electrodes. Corrosion resistance and hot hardness are good up to 1000 F. The material work hardens under repeated impact.

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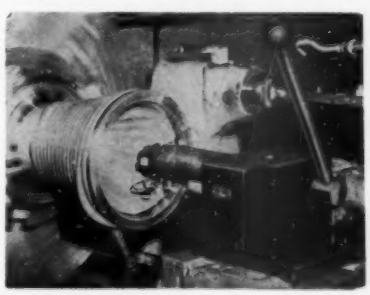
The McKay Co., 1005 Liberty Ave., Pittsburgh 22, Pa. **Circle 460**

### Toolholders Span Wide Range of Lathe Operations

This line of toolholders includes a toolpost for every lathe and a tool adapter for every lathe operation. Five



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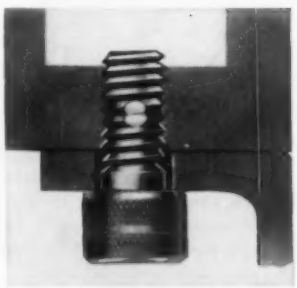
## provides a self-locking grip against loosening due to vibration

For maximum reliability under severest conditions, Bristol offers its complete line of socket screws with the famous NYLOK self-locking inserts, including Bristol Multiple-Spline and hex socket set screws, socket-head cap screws, flat-head socket cap screws, button-head socket screws, ·ocket shoulder screws, and socket pipe plugs. Here are their big features:

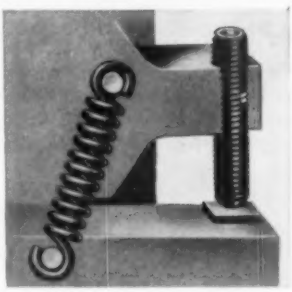
### They LOCK

. . . Bristol socket screws with ı tented NYLOK principle *lock* by means of a tough ɔylon pellet, permanently imbedded in the screw body. The pellet projects slightly beyond the crest of the threads and is compressed when the screw is inserted, setting up a counter-force that creates a strong engagement of the threads opposite the pellet. All necessity for lock washers, or other auxiliary holding devices, is eliminated.



### They SEAL

The NYLOK nylon pellet acts as a dam along the threads of the Bristol socket screw and positively stops all fluid leakage . . . far superior in this respect to ordinary screws which permit fluid leakage along a spiral path between the non-load-bearing thread flanks of screw and threaded hole.



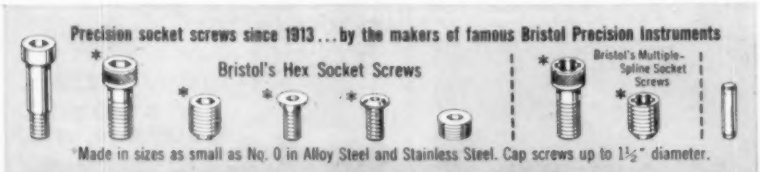
### They ADJUST

. . . and stay adjusted, time after time. Bristol-NYLOK socket screws make ideal adjusting screws because they provide the same effective locking action regardless of whether they are fully seated. And, the pellet's resilience makes it possible to change adjustments with ease and accuracy.

ACCO

Get full data on Bristol socket screws with NYLOK today . . . and remember, Bristol still offers the most complete socket screw line on the market, both plain and with NYLOK. See your authorized Bristol distributor or write the address below. A.O.11

*T.M. Reg. U.S. Pat. Off. The Nylok Corporation.


Precision socket screws since 1913 . . . by the makers of famous Bristol Precision Instruments
Bristol's Hex Socket Screws
Bristol's Multiple-Spline Socket Screws
*Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap screws up to 1½" diameter.

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## TOOLS of today

different series handle operations having swings from 6 to 60 inches and toolbit capacities from ½ to 2 inches.

When the toolpost is set on the compound, it requires no adjustment. On any production run requiring several or many metalcutting operations, the tool adapter can be set in the toolpost, positively locked, the cut made and, when

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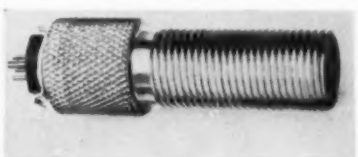
finished, the tool adapter is lifted out vertically and the next tool adapter used in the same manner. The clamping or locking of the toolpost is spring-actuated and assures positive repeating within 0.0003 inch. Vertical dovetailing surfaces reduce the possibility of chip interference.

George E. Kirkelie Co., 8717 Darby St., Northridge, Calif. **Circle 461**

### Magnetic Pickup Measures Speed

Because it generates a voltage or frequency from mechanical motion without contact, the Kineflux pickup is useful for measuring speed, counting revolutions, reversing the direction of motion, speed control, proximity detection and for use as a tachometer



element. A typical application might consist of synchronizing two elements running at different speeds. While the speed comparison is being made, the pickup is energized. After the elements are synchronized, the magnetizing coil is de-energized and the pickup has not further mechanical effect on the system.

Kinelogic Corp., 1256 North Fair Oaks Ave., Pasadena, Calif. **Circle 462**

### Form Tool Blanks Are Solid Carbide

These solid carbide circular form tool and cutoff blanks are for use on Brown & Sharpe automatic screw machines. A steel plug is brazed in the center of each blank. The plug is soft enough to permit drilling and tapping with conventional high-speed steel tools, yet hard enough to prevent the deformation or

stripping of the threads when the tool is clamped in the machine. The blanks are furnished in two standard grades of carbide: Grade DD for use on ferrous materials and copper alloys and Grade A for use on rubber, brass, aluminum and zinc alloys.

Adamas Carbide Corp., Kenilworth, N. J. **Circle 463**

## Ultrasonic Device Seals Plastics

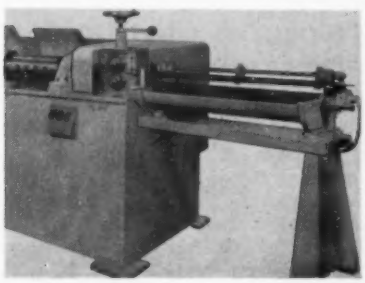
Hermetic, noncontaminated seals for the new, strong polyester plastics are produced by Sonoseal, an ultrasonic device. Ultrasonic vibrations are im-

parted to overlapped sections of the materials to be joined, causing plastic flow and a bonding of the molecules to the interface layers of the materials. Powered by a 100-watt generator, the device has a built-in automatic frequency control device that adjusts to the thickness of the material and applies the power required to effect a perfect seal. Seam widths can be from 0.030 to 0.1000 inch. Depending on the type and thickness of the plastic, the material can be welded as rapidly as 600 ipm.

International Ultrasonics, Inc., 331 Centennial Ave., Cranford, N. J. **Circle 464**

## Straightener, Cutter Ups Wire Production

The Model 300V variable speed twin arbor automatic torsion wire straightening and cutting machine is designed for




Cleveland Tool and Die
CASE FILE

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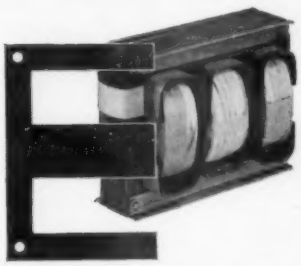
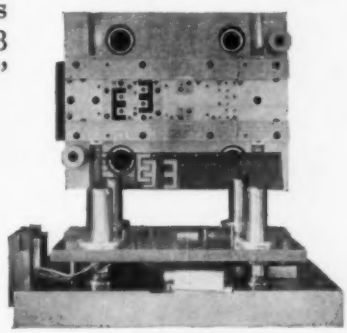
**CTD PRECISION CARBIDE DIES SPEED OUTPUT OF "FRANCEFORMER" LAMINATIONS**



Check the transformer on the next neon sign you see, and chances are it'll read "Franceformer"—trade mark of the France Mfg. Co. of Cleveland, O. This aggressive company supplies leading jobbers of neon signs throughout the country. For high-speed lamination production, France chooses CTD precision tungsten carbide dies. "CTD dies give us continuous production with far less downtime", says Emil Olds, plant manager. "We get 12 to 15 times the die life at only 3 times the previous cost."



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fast production of high-tensile wire from 19 gage to $\frac{3}{32}$-inch diam, or up to $\frac{1}{8}$-inch diam soft basic wire. The machine has two counter-rotating five-station arbors. A variable speed unit provides an infinite feed range. An angled electric control panel gives one-position operation. A sensitive limit switch trips the target, with positive setting and positive release. The clutch is of the solenoid-operated roll type. The drive shaft, arbors and flywheel are mounted on ball bearings. Speed is up to 12,000 8-inch cuts per hour. A smaller version of the same machine, the Model 200V, handles high tensile wire from 0.015-inch to 16 gage. A companion line for straightening and feeding only has no cutter.

Mettler Machine Tool Inc., Boulevard Industrial Park, New Haven 4, Conn. **Circle 465**

## Miniature Limit Switch Has Four Circuits

Available in two actuator designs—plunger model for in-line operating motion and a positive drive rotary linkage unit for operation under adverse dirt conditions, these compact sealed miniature limit switches are of four-circuit design. Size is 1 inch in diameter, $2\frac{1}{2}$ inches high. The air-tight enclosure is filled with an inert gas to assure constant operating characteristics. Switches are rated at 24 amperes inrush and 7 amperes resistive at 28 volts d-c.

Micro Switch Div., Minneapolis Honeywell Co., Freeport, Ill. **Circle 466**

## Control System Uses Two Tape Formats

This contouring control system—a member of the DynaPath-20 series—uses either binary-coded-decimal or straight binary punched tape formats. The straight binary option is suited for computer prepared tapes whereas the work address, binary-coded decimal format is used in point-to-point control systems. With the BCD format, it is possible to make, modify, reproduce and verify tapes on a Flexowriter. Thus, control tapes for simple contouring operations can be prepared without the use of a computer. Computer routines

which produce binary-coded-decimal as well as straight binary tapes are available for processing more complex parts.

Bendix Corp., 21820 Wyoming, Detroit 37, Mich. **Circle 467**

## Magnetic Oil Filter Has Large Capacity

Positive protection for oil hole drilling and reaming, tapping, threading, burnishing and all types of lubrication systems is provided by the No. 5 filter, which has 5 gpm capacity. Permanent magnets remove magnetic particles from oil, coolant or other liquids. The bucket, which has a bayonet lock, is quickly


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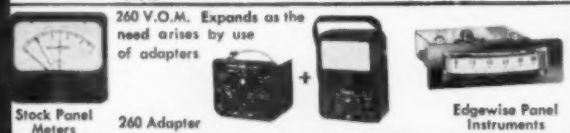


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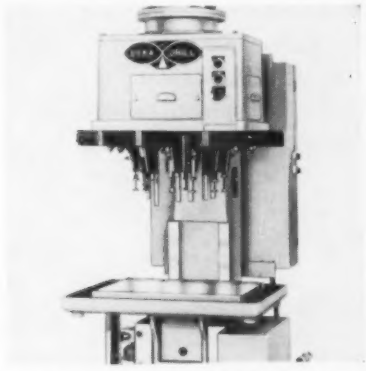
removed. Chips are dropped when released by the control knob for the permanent magnet.

Sinclair Machine Products, Inc., Claremont, N. H. **Circle 468**

## Tapping Machine Completes A Cycle A Second

Known as the Deka.Drill No. HST-714, this multiple spindle tapping machine, is capable of performing up to 60 cpm at 1600 rpm. Suited for all automated type jigs and fixtures, it is equipped with a coolant tank with pump and motor and adjustable arm, and bracket type tapping spindles. Its 14 spindles are adjustable in any pattern within a head area of 7¾ x 12¼ inches.

The tapper is driven by a reversing motor capable of 240 empty plug reversals a minute mounted by direct drive to the gear box. The table is hydraulically operated and can be set for various depths within a 6-inch stroke. The stroke can be held at the top of the cycle, leaving room for manually lowering the table whenever necessary. The table and knee assembly can be adjusted over a 14-inch distance on the column.



Precision Tool and Mfg. Co. of Illinois, 1305 S. Laramie, Cicero 50, Ill. **Circle 469**

## Environmental Chamber Chills Small Parts

This 0.5-cu ft environmental chamber is suited for research and development testing, job shop applications and expansion fit assembly. The Penguin/5 chilling machine occupies less than 2½ sq ft of floor space and is caster-mounted. The standard low temperature range is from −10 to −60 F but the machine is available with a high range to 500 F. The chamber measures 15 x 9 x 8 inches.

Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio. **Circle 470**

## Cylinders Have Adjustable Stroke Length

Among the design improvements incorporated in the Series R cylinders for air or hydraulic service to 200 psi is stroke length adjustment. Cushion kits which can be installed without disassembly to convert noncushioned cylinders to adjustable cushions and built-in metallic rod wipers to automatically compensate for wear are two additional features. The mounting brackets are interchangeable and square feed ring internal locking of heads to barrels eliminates bulky head castings. These cylinders are available in 1⅛, 1½, 2, 3 and 4-inch bore sizes.

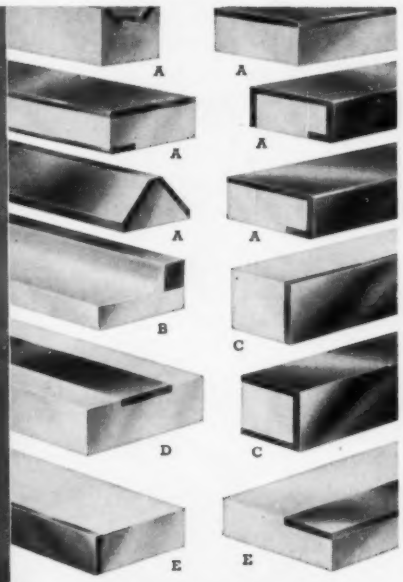
Modernair Corp., 400 Preda St., San Leandro, Calif. **Circle 471**

## Air Platform Floats Jigs, Fixtures

Jigs and fixtures weighing up to several hundred pounds can be moved by machine operators by this floating air platform that floats the work on a thin

*(Continued on Page 216)*


A—Hardened Ways and Slides
B—Composite Die Sections
C—Heel Block
D—Center Clad
E—Flange Slide

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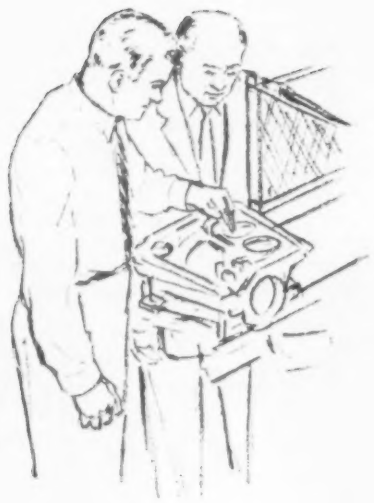
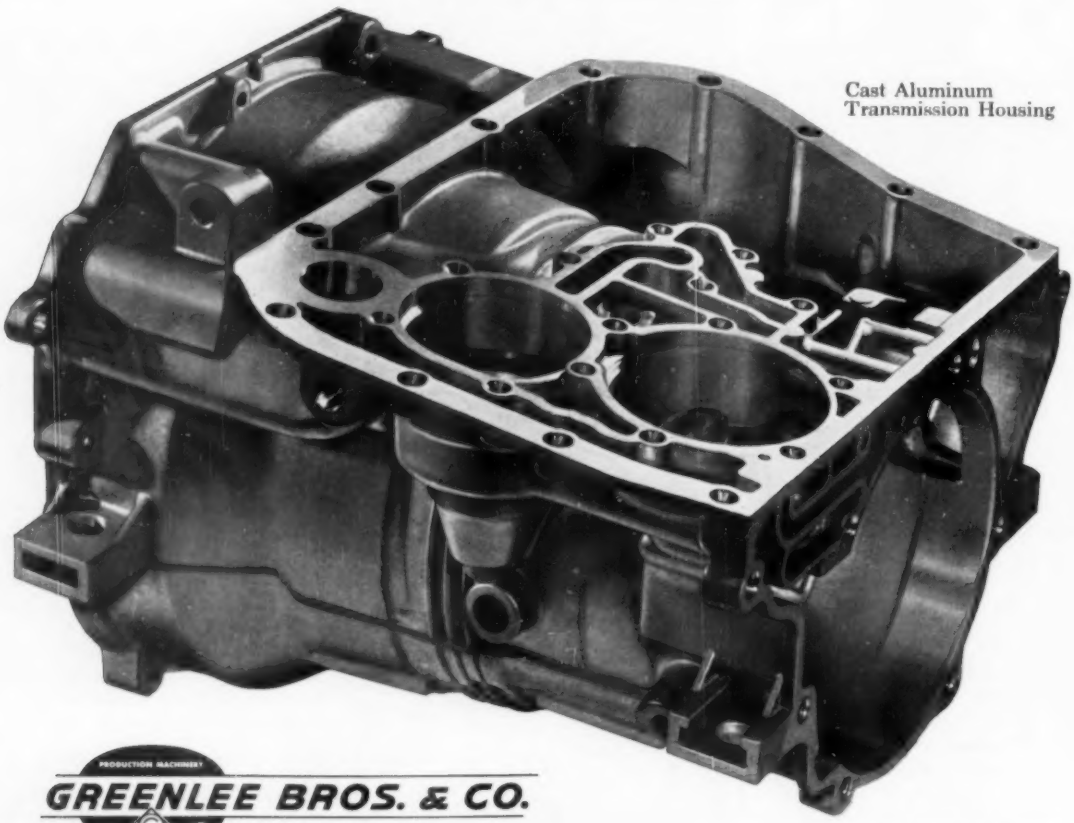
# COOPERATIVE APPROACH to functional part design saves dollars on the transfer line



Tool engineers and product designers know that every functional part must be designed for economical manufacturing as well as function. That's why they welcome the suggestions of Greenlee engineers — *before* the design is finalized. Problems of handling, locating and positioning are more easily solved. In many cases Greenlee cooperative engineering has saved thousands of dollars in capital equipment and reduced unit costs. Some of the largest users of mechanized production equipment have taken advantage of the helpful suggestions offered by Greenlee engineers. Their thinking is sound . . . respected. Write or call for complete information. Greenlee has a Detroit office located at 2842 West Grand Boulevard for your convenience. The phone number is Trinity 2-3928.



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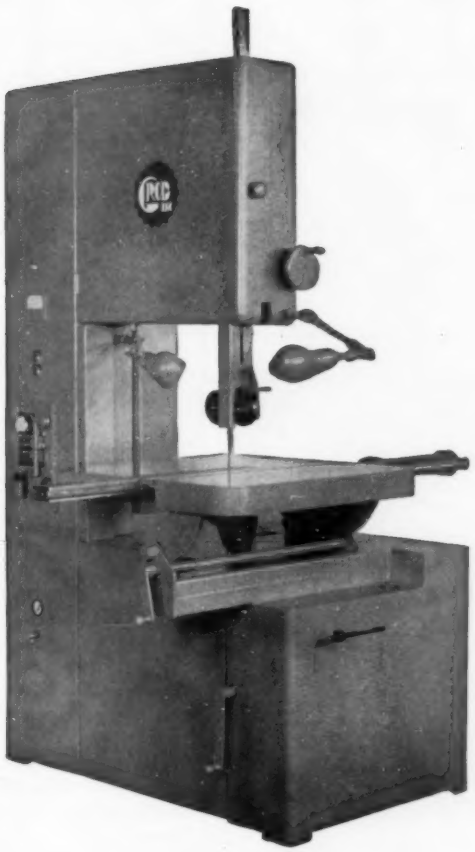

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What will you see? Well, there will be some of our new instruments plus a device that we are poppin our buttons about. We will be a little mysterious about this and just say that surface plate flatness can now be measured and recorded automatically. This will be a demonstration that you will not want to miss.

We will have company engineers on hand and our representatives in various parts of the country to answer any problems you may have in optical tooling.

If you are going to the show we hope that you will clip this out and put it in your wallet as a reminder to stop in and see us in BOOTH 3833.

**DAVIDSON OPTRONICS, INC.**
2223 Ramona Boulevard
West Covina, California

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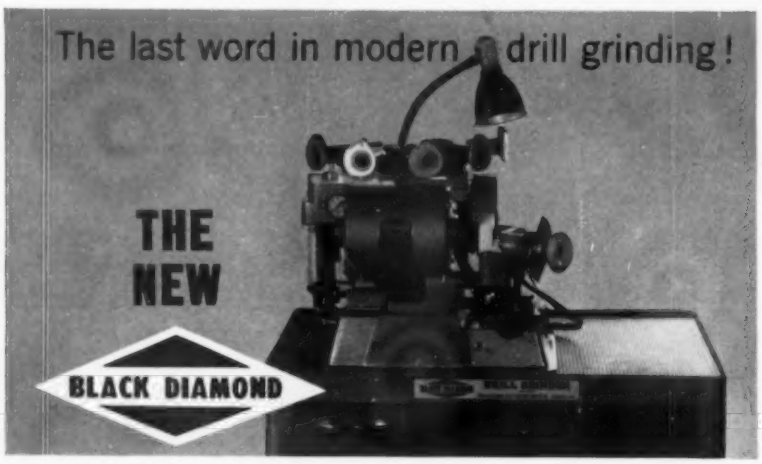


*drill grinder with 7 new features:*

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Natick, Mass. — Manufacturers of Black Diamond and Worcester Drill Grinders.
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## TOOLS of today

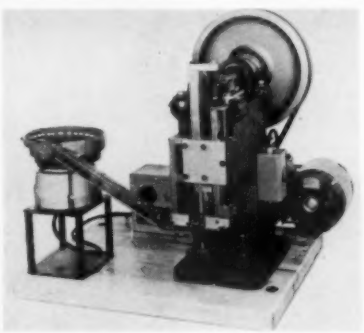
*(Continued from Page 209)*

film of air. The platform is an alloy-iron plate. Tiny orifices in the plate control a metered amount of air, allowing it to follow in a predetermined pattern, lifting the load a few thousandths of an inch above the machine table, even if the table has holes or T-slots. The platform comes in two sizes—6 inches and 10 inches long. Both sizes are 5⅞ inches wide, 1⅛ inches thick.

Sperman Metal Specialties, 2199 E. 21st St., Brooklyn 29, N. Y. **Circle 472**

### Riveter Inserts, Sets All Types of Terminals

This turret terminal riveter inserts and sets all makes of electronic terminals, base pins, etc., at speeds in excess of 2000 per hour. It is especially suited for setting electronic terminals in printed circuit boards and other electronic components. Operated by an



electric foot switch, the Model 900 uses a vibratory hopper and electrically interlocked microswitches to insure continuous flow of the terminals to the riveting jaws. The hopper and track handle varying lengths of turret terminals with no change in tooling. A ⅓-hp motor powers the machine.

Eyelet Tool Co., 31 Carleton St., Cambridge 42, Mass. **Circle 473**

### Revolving Stock Stop for Turret Lathes

Bar stock can be fed through the collet while the turret lathe is running, using the Sturdimatic revolving stock stop. The ball bearing head of the stop eliminates galling or scoring of the bar while it is rotating and the

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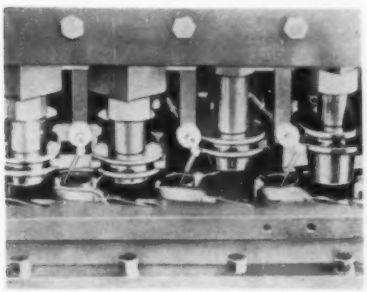
bearing is grease sealed for life. The stop comes in standard straight shank sizes.

Sturdimatic Tool Co., 3900 F St., Detroit 16, Mich. **Circle 474**

## Overload Detector Stops Press

Potential overload in slide transfer machines is detected and the press stopped before the overload occurs by this electronic control device. Called the Autotransfer, it accomplishes this check by detecting the failure of a part to transfer from one station to the next. The unit automatically compensates for

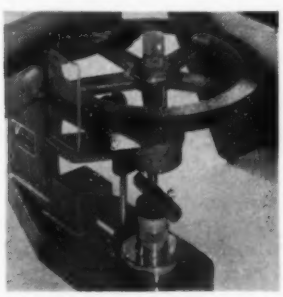


temperature changes and voltage fluctuations, as well as for normal mechanical changes which occur in a slide transfer machine. It has built-in auxiliary provisions for protecting machinery from such dangers as buckling, end-of-material and misfeed.

Wintriss Controls, Div. of Industrionics Controls, Inc., 20-24 Vandam St., New York 13, N. Y. **Circle 475**

## Light Wave Micrometer Reads Directly

Reading directly on the handwheel to 0.00010 inch and on the vernier to 0.00001 inch (ten millionths), this light wave micrometer has a capacity of 0 to 2 inches. An unskilled operator can learn to accurately duplicate readings. Intended as an inspection standard, the micrometer directly measures basic standards, plug gages, measuring wires and setting blocks, and checks roundness of cylindrical shapes. Pitch dia-

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## 2 Machines-in-One $8950

Automatic Reciprocating Movement of the Spindle and the Table

Magnetic Brake on the Motor Variable Speed Drive

Table 12" x 48"
Feed 12" x 18"
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Rapid Traverse and Power Feed to the Table
• •
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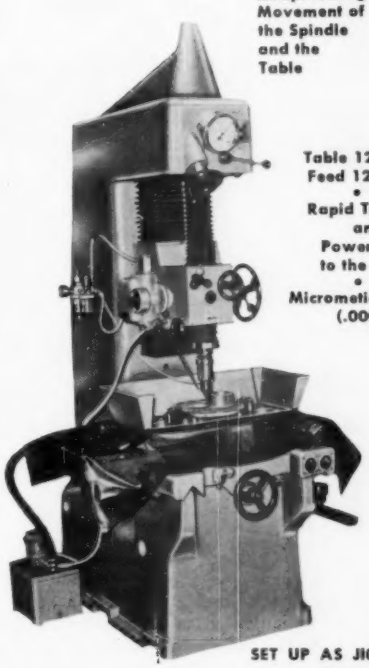
Maximum Distance Spindle to Table 25½" or 31½"

Micro-Feed



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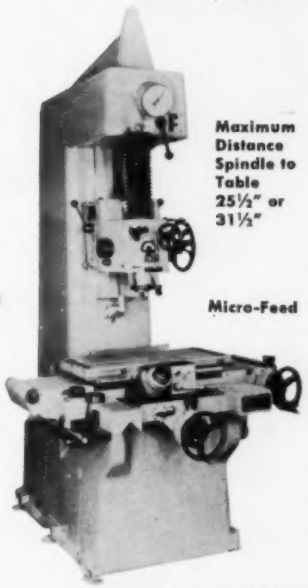

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VR2
HIGH SPEED

Table 12" x 48"

FR3
BORING and MILLING
4.2 HP Motor for Spindle

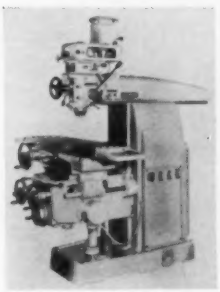
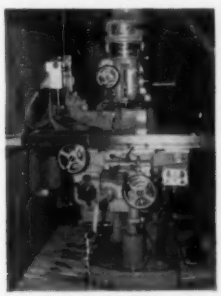


Table 13" x 59" Power Feeds and Rapid Traverse in All Directions. No. 40 Taper. Net Weight 5,300 lbs.

VR2
HYDRAULIC COPYING MACHINE



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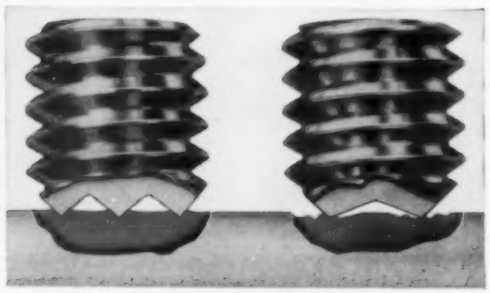
**ALL THIS — AT NO INCREASE IN PRICE!**



Cutaway of W-Point Socket Screw (left) shows more even tracking, better contact than conventional cup-point variety (right).

*Look to P-K® for socket screws for every design requirement*— including the vibration resistant LONG-LOK with nylon-type polymer insert—the most complete line in the industry.

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meter of threads and gears can also be measured. It can be used for quality control at screw machines, grinders or lapping machines, or for checking of components before or after assembly. Laboratory applications include measurements of experimental parts, coatings, and expansion and contraction. The micrometer can also be used as a plastometer for evaluation of other characteristics of glass, rubber, plastics and textiles.

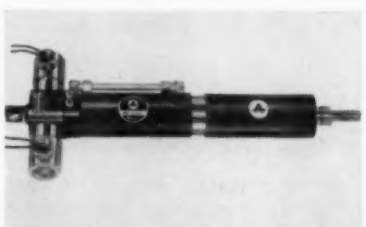
The Van Keuren Co., Watertown, Mass. **Circle 476**

## Air-Hydraulic Tandem Cylinders

Type BVT tandem cylinders consist of a valve-in-head cylinder and a double-acting cylinder mounted in line and having a common head at the center and two pistons mounted on one solid rod. The cylinders are available in bore sizes of 1½, 2, 2½, 3 and 4 inches and in lengths up to 80 inches.

The units are intended to combine all advantages of valve-in-head cylinders with the advantages of hydraulic control of an air-operated cylinder. The hydraulic fluid can be used either in the front cylinder or in the middle section of the unit without a make-up chamber.

Air speed controls are provided in the valve section of the valve-in-head



cylinders and hydraulic speed control is obtained by piping flow control valves in series with the two ports used for the hydraulic section. By using air pressure in both sections, the usable force is twice as great as the force obtainable form a standard cylinder of the same size.

Allenair Corp., 255 E. 2nd St., Mineola, N. Y. **Circle 477**

## Shaft Collar Provides Tapered Lock

Combining a conical-shaped split inner ring and a locking retainer ring, the Taper-Lock shaft collar withstands thrust loads in one or both directions. The inner ring locks into the shaft,

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Deposits have excellent quality and adhesion.

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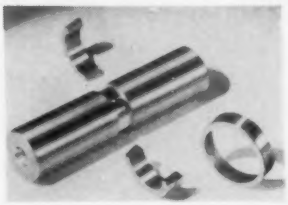
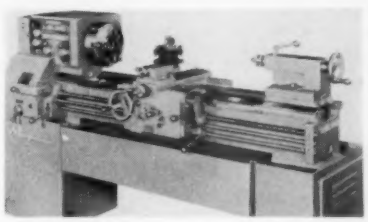


eliminating turned shoulders, and the assembly is completed by the tapered fit of the inner ring and the retainer. The device can be used also to connect air or hydraulic cylinder shafts to other machine parts. It is available in sizes to 4 inches in diameter.

Bearing Accessories Co., 7320 Lake Shore Blvd., Mentor, Ohio. **Circle 478**

## Lathe Line Has Redesigned Headstocks

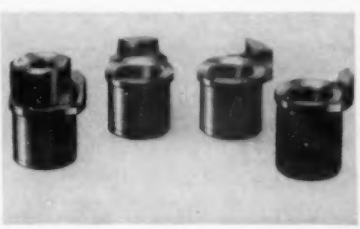
Included in the Regal lathe line are 10 models ranging in capacity from 13 to 24 inches; 17 and 19-inch plain bed gap models; and 17⅞s and 19⅞s-inch sliding bed gap models. The headstocks have three-bearing spindles, are automatically lubricated and are equipped with totally enclosed quick-change boxes and compensating V-ways. The motor is enclosed in the head leg.



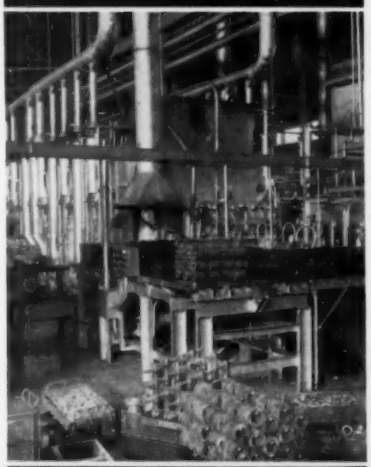
R. K. LeBlond Machine Tool Co., Madison and Edwards Rds., Cincinnati 8, Ohio. **Circle 479**

## Drill Bushing Liners Eliminate Lockscrews

Drill bushing lock liners called Un-A-Lok eliminate the lockscrew required to secure slip-renewable type drill bushings in place. A finger-tip twist of




# HOLCROFT



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Working with these materials:

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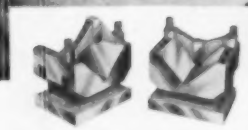
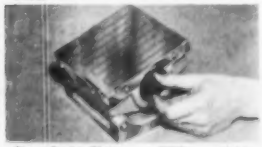
# MACHINE and INSPECT... with Tools You Can Trust!

**Angle Irons** — six precise working faces — ground square or parallel within tenths — shown here with Versachek Electronic Gage.

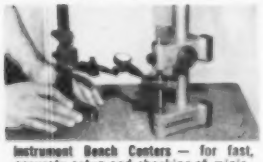


**V-Blocks** — Vees ground central with sides, parallel with bottom, square with ends within tenths. All surfaces square or parallel within tenths.

**Magnetic Angle Iron** — Combines universal right angle iron and magnetic chuck to speed workholding and eliminate clamping. Used on side, back and ends.



**Sine Angle Plates** — With precision ground .100" step on base plate for easier simple or compound angle setups. With or without permanent magnet chuck.



**Instrument Bench Centers** — for fast, accurate setup and checking of miniature and sub-miniature parts. Part of a Bench Center line with capacities to 10" diameter and larger.

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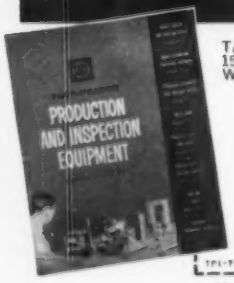


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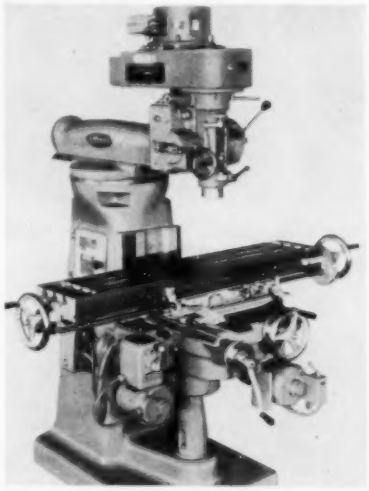
## TOOLS of today

the bushing either locks it in the liner or removes it, as desired. During drilling, the bushing is locked securely in the liner by rotation of the drill. Economies are realized, since layout, drilling and tapping of lockscrew holes are eliminated.

American Drill Bushing Co., 5107 Pacific Blvd., Los Angeles 58, Calif. **Circle 480**

## Vertical Mill Has Tilting Head

The Model 645 ram and turret mill is intended for production or toolroom use. It is a vertical machine, with a head that tilts 45 deg forward and back and rotates 360 deg on the ram. The turret rotates 360 deg on the column



and the power assembly rotates 360 deg around the spindle. These features, plus 18-inch knee travel and 25½-inch overarm travel simplify setup and provide for setting of any compound angle.

Distance from spindle to table ranges from 0 to 19½ inches and there is a distance range of 1½ to 27 inches from the centerline of the spindle to the column ways when the spindle is in a vertical position. Gross travel of the table is 10 inches. Longitudinal travel is 26 inches. The spindle has a vertical travel of 5 inches. Nine spindle speeds are provided with the standard 1-hp motor and there are three spindle feeds with adjustable depth, power feed up as well as down.

Index Machine Co., Jackson, Mich. **Circle 481**

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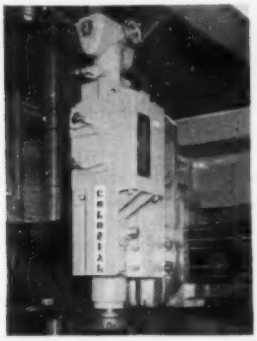
## Milling Spindle Gives Varied Speed, Constant Hp

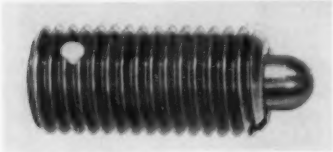
This hydraulic milling spindle combines infinitely variable speed with constant horsepower. As its speed is reduced, the amount of torque produced increases in direct proportion. The result is maximum chip load per tooth. The spindle is a compact unit adaptable to either existing equipment or new setups. It is available with horsepowers from 10 to 50.



Colonial Broach & Machine Co., 21601 Hoover Rd., Warren, Mich. **Circle 482**

## Spring Plungers Are Self-Locking

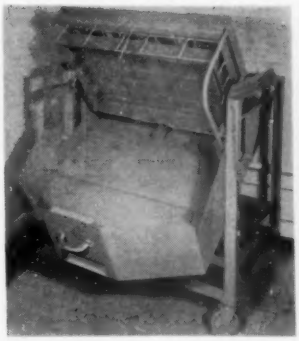
When one of these spring plungers is in place in a die, jig, fixture or detent, compression of a Nylock pellet creates a springlike wedging action which locks the mated threads together. These inserts eliminate the need for setscrews or other methods of locking spring plungers. The inserts permit a positive lock that is vibrationproof.



Harco Engineering, 12092 Woodbine Ave., Detroit 39, Mich. **Circle 483**

## Material Handler for Heat Treating

A combination dump cart and hopper simplifies the handling of small parts in conjunction with heat treating operations. Basically, the cart consists of a dolly with a tilting roller platform and a hopper. In operation, the basket load of parts is rolled onto the platform where the basket is clamped into position. A drain pan under the rollers collects excess oil accumulated during quenching operations. The hopper chute is then opened and the platform is rotated to pour the parts into the hopper. An opening at the narrow end of the box permits controlled feeding of the parts into tote boxes. With the hopper chute folded in, the platform can be locked in the horizontal position, allowing the unit to serve as a dolly. It can roll into position to manually load or unload a battery of furnaces.



Ipsen Industries, Inc., P. O. Box 500, Rockford, Ill. **Circle 484**

## Servo Actuator Provides Accurate Positioning

Machine tools and presses requiring precise positioning can use the Model 410 servo actuator. A self-contained unit, it gives positioning accuracy of better than one part in one thousand. It can be furnished with stroke lengths from 1 to 6 inches and cylinder diameters from 1¼ to 2½ inches. A built-in power supply allows command by either

***He's Watching a Band Sawing Miracle***

This band saw operator at the Bell & Gossett Company plant in Morton Grove, Illinois, is watching "Controlled Accuracy"... accuracy, being held to within a few thousandths of being perfectly straight, and he can actually *see* the band blade being guided in the saw cut to produce this accuracy! No further machining is required before the pipe is welded into an assembly for a Bell & Gossett Heat Exchanger Unit.

Band sawing accuracy like this is nothing short of miraculous—especially when it can be done on a high production basis, as Bell & Gossett is doing. And when the same tolerances can be held on cut-off pieces from 2" to 18" in diameter, this MARVEL #81 Band Saw Machine can be truly called a precision machine tool.

The secret of this amazing sawing accuracy is in the MARVEL "SURE-LINE" Automatic Accuracy Control—a simple and extremely effective electro-mechanical servo-mechanism that continuously senses and automatically corrects any tendency of a band blade to drift to either side of a desired line of cut. The "SURE-LINE" unit literally "steers" the blade to make a straight cut. This permits the use of heavier feed pressures and, when desirable, higher blade speeds, to do the work faster, without sacrifice of accuracy. Incorporated in the new MARVEL #81 Series High Speed Heavy Duty Hydraulic Band Saws, the "SURE-LINE" permits full utilization of all the advantages of high speed steel band saw blades—while extending their usable blade life as much as 50%.

**Before you buy any band saw machine, get complete details on MARVEL #81 Series Single Cut, or Automatic Shuttle Type Bar Feed Production Band Saws—the machines DESIGNED AND BUILT TO REDUCE SAWING COSTS. *Write for catalog today.***

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MARVEL Metal Cutting SAWS

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potentiometer or external electrical signal. At speeds to 40 ips and frequency response to 40 cps, the maximum output thrust is 5 tons. Control can be either local or remote. The servo-amplifier, mounted with the actuator, permits on-site adjustment of control functions.

CompuDyne Corp., Hatboro, Pa. **Circle 485**

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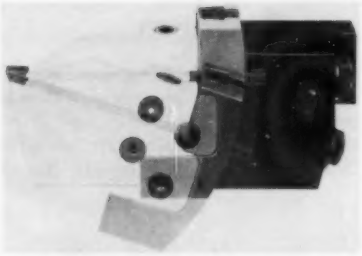
## Cut-Off Tool Is Infinitely Adjustable

Rake angle settings with the Manchester cut-off tool range from zero to 16 deg as shown in the illustration. Although settings are marked in multiples of 2 deg, the tool is not serrated. Thus, the tool is infinitely adjustable. The position angle is held rigid by two locking screws and a T-slot. The point of application of cutting force is at center regardless of angle settings. New rake angles can be set without removing the

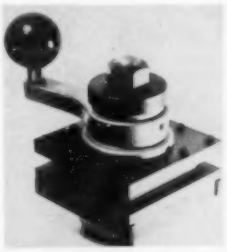


tool from the machine and without losing center location. A V-insert blade support assures accurate location of the insert. The tool fits all makes of turret lathes, production lathes, automatics and cut-off machines. Inserts are available in various grades of carbide, high-speed steel and cast alloys.

Portage Double Quick, Inc., 1054 Zweitzer Ave., Akron 11, Ohio. **Circle 486**

## Four-Position Turret for Engine Lathes

Dependable repeating accuracy and fast operation are offered by this four-position automatic indexing turret for engine lathes. One movement of the ball-handled lever forward and back unlocks the turret, indexes to the next



tool position and relocks for the cut. The turret is mounted directly on the compound slide rest of the lathe. It is available for 12-inch through 16-inch machines.

Westwood Engrg. Co., 2234 Purdue Ave., Los Angeles 64, Calif. **Circle 487**

## Machine Grinds Pump, Injector Parts at 10,000 rpm

Developed primarily for grinding fuel pump and injector parts, the Model U-800-A Unitest grinder has V-block fixtures to grind laps or stems from 1/8 to 5/8 inch in diameter and from 5/8 to 9 inches in length. Using cast iron, stainless steel or stone lapping arbors turning at 10,000 rpm, the grinder has both grinding wheel and quill drives, belt-driven by separate motors, assembled to the fixed or movable beds of the tool. The quill drive is by a speed reducer motor. Rotation of the table for angular setting is by a vernier handwheel graduated in incre-

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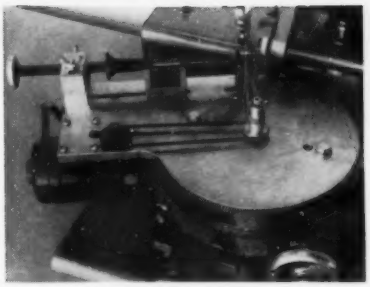
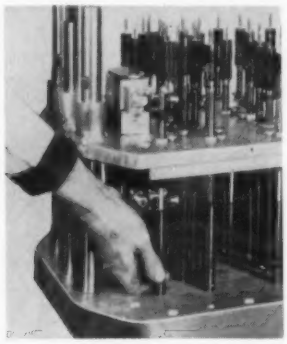


ments of 3 min. Angles from absolute parallel to a maximum of 160 deg can be ground. Accessories with the grinder include two balanced 2-inch grinding wheels, an adjustable lamp for illumination of the work, guide blocks with a $R_C$ hardness of 50/55, diamond wheel dresser and fixture and quill drive belts.

Marine Pumps, Inc., Div. of Diesel Control Corp., 226 N. Marine Ave., Wilmington, Calif. **Circle 488**

## Drilling-Tapping Heads Have More Versatility

Simultaneous tapping of holes with as close as 5/16-inch centers is possible by incorporating individual spindle leadscrews in drilling-tapping heads. The spindle leadscrews are designed to op-

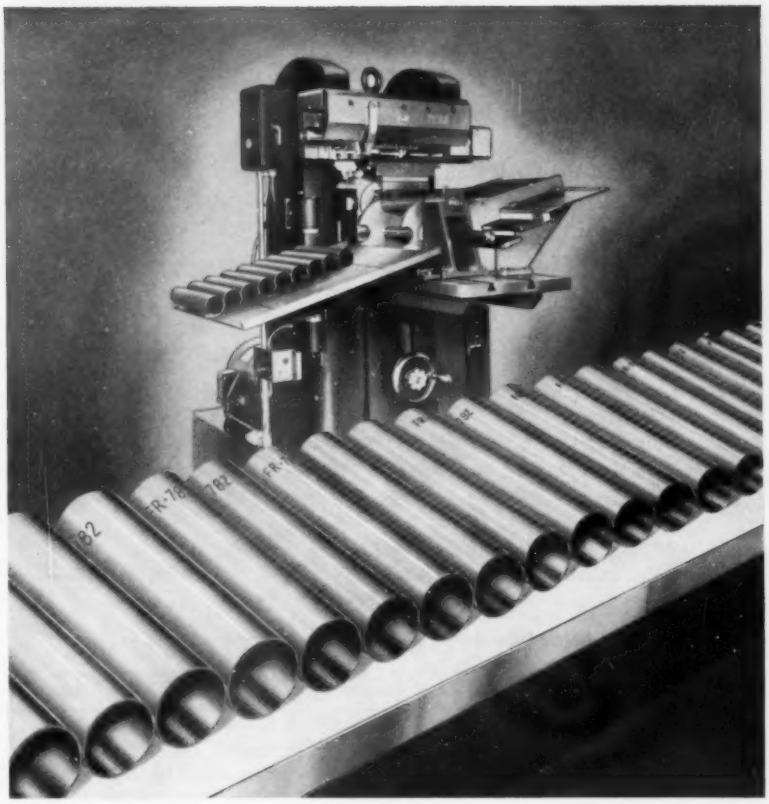


erate on the same close centers as the spindles to which they are attached. The head illustrated contains 73 spindles with 32, 40, 48 and 56-pitch leads.

Zagar, Inc., 23892 Lakeland Blvd., Cleveland 23, Ohio. **Circle 489**

## Roller Bearing Speeds Hobbing

Bearing heating and seizures are eliminated with a roller bearing that replaces the usual bronze bearing at the outboard end of a hobbing machine arbor. Use of the roller bearing permits faster feeds and speeds, results in better finishes and prolongs cutter life. The bearings are installed without machine rework, require no extra space and can be taken from one machine and in-

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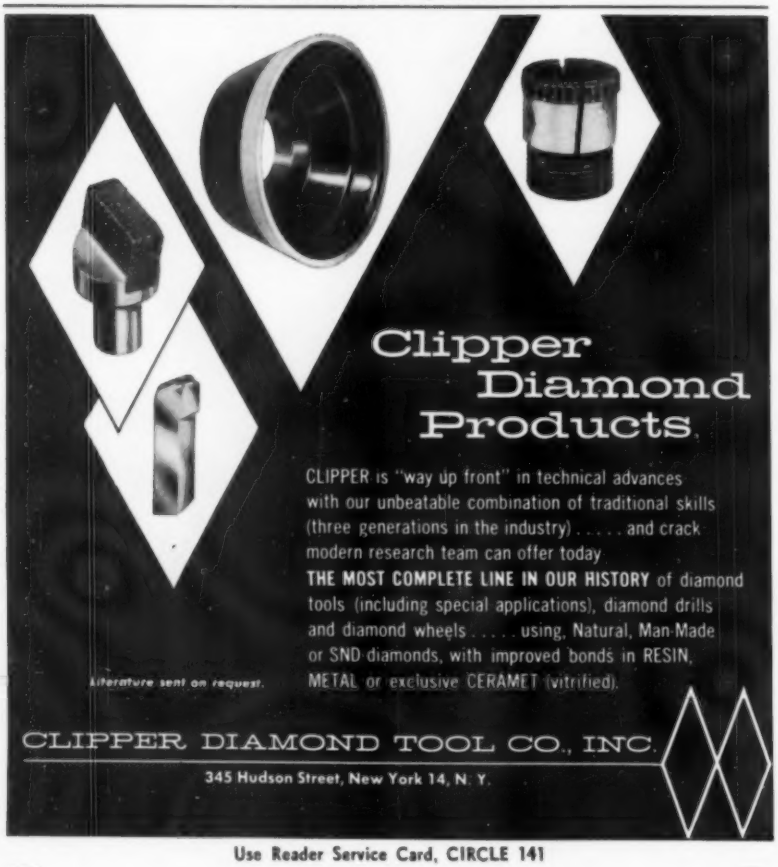
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## TOOLS of today

stalled on another. No adjustments are required and lubrication is provided by the hobbing machine lubrication system.

Sonnet Tool & Mfg. Co., 580 N. Prairie Ave., Hawthorne, Calif. **Circle 490**

## Automatic Control Has Many Applications

Intended for punch presses, drill presses, drilling machines, multislide and four slide machines, wire machines, screw machines and other automatic equipment, the Prescon automation control system instantly shuts down the machine in the event of malfunction and indicates the source of trouble. This permits unattended operation. The unit is a compact package containing one to

five completely interchangeable sensor models, available in many combinations for different jobs. Power requirement is 110-120 volt a-c. The circuit is transistorized, tolerates wide line voltage fluctuations and performs at speeds in excess of 1000 cycles per minute.

W. J. Saeman Co., Inc., 256 First Ave., S. W., Carmel, Ind. **Circle 491**

## Shock Chambers Have Fast Pulldown, Warm-Up

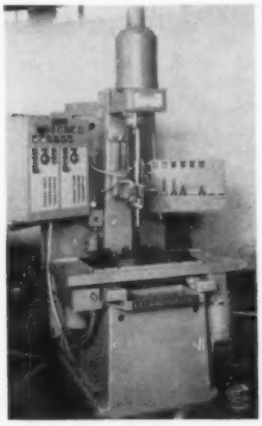
Designed for bench top operation, these thermal shock chambers have a work area of ½ cu ft. A completely removable, file drawer type door gives access to the 16 x 8 x 8-inch chamber. Ultratemp Model 600 operates between −100 and +500 F with a 5-min pull-down and a 30-min warm-up. Model

800 has a low temperature of −320 and a high of +500 F. Each is instrumented to an accuracy of ± ½ F. Both models are protected by 3 inches of insulation.

Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio. **Circle 492**

## Drilling Machine Is Tape Controlled

Single-part, short-run or continuous production drilling is possible with this tape-controlled machine. Single part operation can be controlled from the keyboard of the General Electric Mark II numerical position control or the



coordinates can be dialed on a console mounted on the drilling machine. For repetitive work, standard 8-channel punched tape is used with a fast tape reader. The program can include automatic reversal for tapping and instant stops for tool and speed changes, as indicated by tool change lights. Positioning accuracy is ±0.001 inch, non-accumulative, with repeatability of ±0.005 inch.

The drilling unit incorporates a ball bearing spindle, zero float, quick-change chuck, six-station turret depth stop and 5-inch traverse hand feed. A choice of spindle speeds from 150-1800 rpm or 150 to 3600 rpm is available. Drilling capacity is equivalent to ⅞-inch diameter in cast iron.

Leland-Gifford, Worcester 1, Mass. **Circle 493**

## Machine Shear Forms Light-Gage Metals

The No. 12 Floturn machine is specifically designed for the shear forming of light-gage metals. Operation is all-hydraulic, including automatic tracer control of the machine's single forming roller. Parts up to 12 inches in diameter

and 15 inches long can be produced on the 4-foot wide, 10-foot long machine. It is equipped with an 8-speed spindle drove from a 15-hp motor. Variable speed drive is optional.

Floturn Div., The Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio. **Circle 494**

## Coil Stock Feeder Has Disk Brake

This roll feed feeds coil stock at speeds to 450 press strokes per minute. Operation is by an eccentric hub from the press crankshaft. The top roll has a release and lockout device for starting and adjusting the stock which automatically resets with the downward movement of the press ram when stamping is resumed. The disk type brake is air cooled with a fin type housing. The disk linings are easily replaced. Model RF-6060 is available in 15 sizes with maximum feed lengths from 2 to 12 inches and stock widths from 2 to 12 inches.

Cooper Weymouth, Inc., 600 Honeyspot Rd., Stratford, Conn. **Circle 495**

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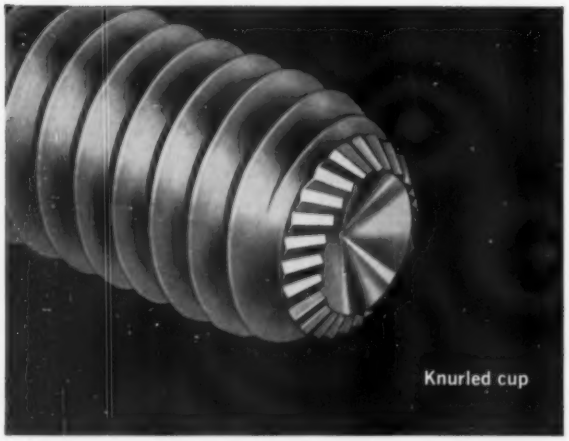


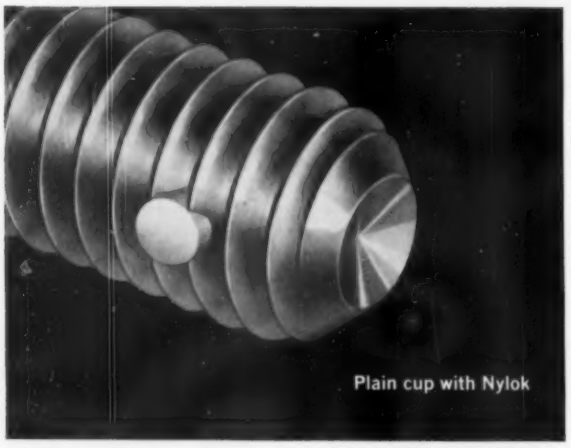

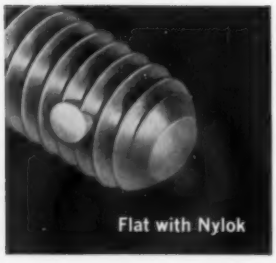

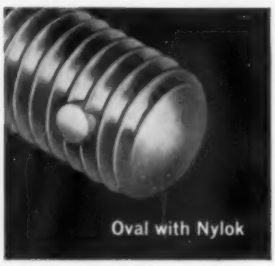


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**UNBRAKO Cone, Half-Dog, Flat and Oval Points.** Sometimes neither the knurled cup nor the plain cup with Nylok will suit your assembly's requirements. Then one of the following point types will be chosen:

- **Cone**—for permanent location of parts; as a pivot in machine design (when point has hardness of at least RC 45); for making fine adjustments over a limited distance.
- **Half-Dog**—for permanent location of parts; in place of dowel pins; against hardened members or on hollow tubing when Nylok insert is also used.
- **Flat**—for frequent resetting of one machine part in relation to another; as an adjusting screw for fine linear adjustments; where wall is thin; on top of plugs made of soft material.
- **Oval**—for frequent adjustment without excessive deformation of part against which it bears. Also for seating against angular surface.

To build in a guarantee of locking, you will want the Nylok feature on all set screws except those with the knurled cup point.

• • •

UNBRAKO socket set screws are available in sizes #0 through 1 in. in alloy and #0 through ½ in. in stainless steels. Your authorized UNBRAKO distributor has a *complete supply* always on hand. For booklet on UNBRAKO High Torque Set Screws, write to Standard Pressed Steel Co., INDUSTRIAL FASTENER DIVISION, SPS, JENKINTOWN 37, PENNSYLVANIA.

*Standard, at no extra cost †T.M. Reg. U.S. Pat. Off., The Nylok Corporation

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*where reliability replaces probability*

# Men at Work

Taylor Fibre Co. of Norristown, Pa., recently announced the election of EDWARD H. DACOSTA (pictured) as president and JOHN M. TAYLOR, JR. (pictured) as chairman of the board. DaCosta joined Taylor in 1938 as a sales correspondent, held many positions of increasing importance and was elected to the board of directors in June 1959. A member of the board of sponsors of the annual Electrical Insulation Conference, he also serves as a director of the insulating materials division and chairman of the Vulcanized Fibre Section of the National Electrical Manufacturers Assn. Mr. Taylor joined the company in 1946 as an expediter in the sales department and, in March 1957, he was elected president of the company. With his other duties he serves as a director of the Allied Gas Co.

LEONARD C. BARR has been elected president of Eutectic Welding Alloys Corp. to replace RENE D. WASSERMAN (pictured), who has been elected chairman of the board of directors. Wasserman, president since the company was founded in 1940, has also been director of research. Barr, a civil engineering graduate of the University of Illinois, has worked with Owens-Corning Fiberglas Corp. and Nelson Stud Welding Corp. He was founder of Gregory Industries where he remains a director and, concurrently, he is a director of Wakefield Co., and a member of the American Management Assn., American Welding Society, National Industrial Conference Board and Cleveland Engineering Society.

The newly created position of vice president in charge of sales of hydraulic products at Racine Hydraulics & Machinery, Inc., has been filled by GEORGE A. VERHAEGHE (pictured). Verhaeghe has been associated with Racine Hydraulics for the past 14 years.

Four new appointments have been made by Brown & Sharpe Mfg. Co., Providence, R. I. EDWARD KIBBITT has been appointed supervisor of subsidiary operations and will be in charge of cutter shop operations, sales, engineering and management coordination. HENRY A. SZOSTEK is now manager, eastern sales district. FRANK E. MONTIE became factory manager of the cutting tool division at the Greystone plant. The responsibilities of plant superintendent, also at the Greystone plant, are now assigned to T. RUSSELL HALL, former assistant superintendent under Montie.

ROBERT H. PRESNALL has been appointed general sales manager for Gisholt Machine Co., Madison, Wis. He will assume the duties of Robert H. Bruce, vice president in charge of sales.

Edward H. DaCosta

John M. Taylor, Jr.

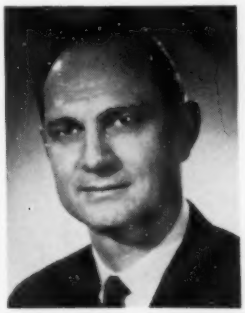
Selection of CHARLES G. MACKIE, for the newly created position as chief engineer in charge of new products, has been announced by Chicago Screw Co., Bellwood, Ill., a division of Standard Screw Co. Mackie, associated with the company since 1947, has been director of engineering for the past six years.

In addition to his present duties as manager of the military products division and management representative for Applied Research Laboratories, WILLIAM A. KERR (pictured) is a recently elected vice president of Bausch and Lomb. Kerr, a graduate of Stevens Institute of Technology, was previously associated with Baldwin-Lima-Hamilton Corp. as general sales manager of the electronics and instrumentation division and with Tracerlab, Inc. as vice president and general manager.

Previously foreman, plant superintendent and, in 1948, plant manager of Philadelphia Gear Corp., WILLIAM T. BROWN has been named vice president in charge of manufacturing. His appointment became effective Jan. 1.

FRANCIS H. GERLACH (pictured) has been elected vice president of engineering as part of a reorganization program at DeWalt, Inc., Lancaster, Pa. After graduation from Indiana Technical Col-

Rene D. Wasserman

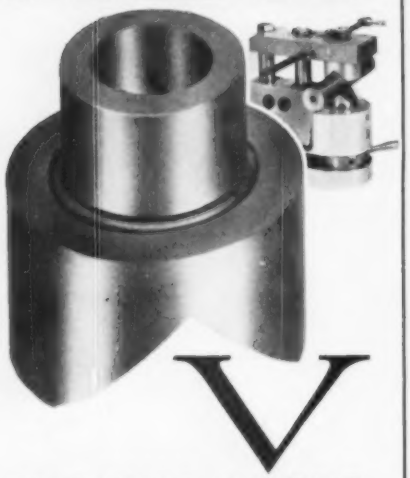


George A. Verhaeghe

William A. Kerr

Francis H. Gerlach

# NEW



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## Men at Work

lege in 1936, Gerlach joined Westinghouse Mfg. Co. He was chief of commutations on fractional horsepower motors and carried out special assignments for Oak Ridge and the British Admiralty during World War II. Later Garlach joined Lamb Electric Co., and then Han-Kor, Inc. Since 1960 he has been vice president of engineering at Porter-Cable Machine Co.

Continuing to serve as the group executive in charge of Bendix Products Div. and Sheffield Corp., as well as Sheffield's associated companies, CHARLES E. HEITMAN, JR., recently took over the duties of president and administrative committee member of Bendix. In the past, he has held various engineering posts with Pullman-Standard Car Mfg. Co. and Budd Co. In 1940, he joined A. O. Smith Corp., where he served as assistant general manager from 1953 to 1956. Subsequently, he was named president of ACF Industries' Carter Div.

Formerly general manager of the Beryllium Corp. nuclear division, EDMUND M. VELTEN has been promoted to vice president of production. In this position, he will be responsible for production operations of both the alloy and nuclear divisions. He entered the Corps of Engineers of the U. S. Army in 1943 and, since then, has held many positions with the Atomic Energy Commission. His principal responsibilities centered around the direction of beryllium and zirconium production. He has been with Beryllium Corp. since 1957.

New vice president in charge of engineering at Philadelphia Gear Corp. is HAROLD O. KRON. Kron joined the firm in 1948 and, prior to his recent appointment, was chief engineer.

Kennecott Copper Corp., New York, N. Y., announced the election of EDWARD L. STEINIGER and ALBERT GREEN to the board of directors filling the vacancies created by the retirement of EDMOND A. GUGGENHEIM and CHARLES SAWYER. Steiniger, president of Sinclair Oil Corp., has been associated with the company for 25 years. Green is vice president, treasurer and director of Murry and Leonie Gugginheim Foundation.

Replacing H. L. HUNTSINGER, who has resigned his position as executive vice president and general manager of Potter and Brumfield, is ZEKE R. SMITH. Prior to joining the American Machine & Foundry Co. division, Smith was associated with Bendix Aviation Corp.,


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Vendo, Inc., and with Airborne Instrument Laboratory. His employment with P & B began in 1953. In 1960, he was named vice president of marketing and technology. During World War II, he was a radar instructor for the Army Air Corps. Huntsinger, who plans to open his own manufacturers' representative agency in metropolitan New York, will handle the P & B relay line in this territory.

JOHN F. LEPINE, JR., and VERNE E. MOUNTEER have both become vice presidents at Copper and Brass Sales, Inc. Lepine, Detroit sales manager since 1953, has been with the company for almost 21 years and fills the position of vice president in charge of sales and advertising. Mounteer, perviously general manager, is vice president in charge of the Cleveland plant. He has been with the company for 25 years.

**J. Algot Johnson**

J. ALGOT JOHNSON (pictured) has been named vice president in charge of research and engineering at Nylox Corp., Paramus, N. J. The position was previously held by J. E. JOHNSON who has been made president of Aerospace Nylok Corp. J. Algot Johnson has been affiliated with the U. S. Army transportation research and engineering command, ACF Industries and Thermal Research and Engineering Corp.

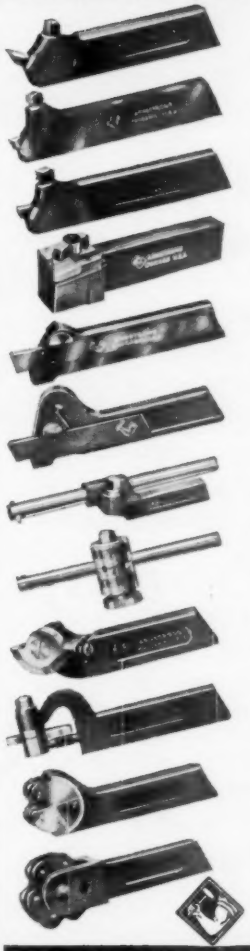
The board of directors of Black & Decker Manufacturing Co., Towson, Md., has elected ROBERT C. TYO to the newly created position of vice president of DeWalt, Inc.. Tyo resigned as president of Porter-Cable Machine Co., Syracuse, N. Y., to accept this position. He joined Porter-Cable in 1943, advanced to vice president in 1953, and was elected president in 1958.

RICHARD L. HOPKINS has joined Accurate Specialties Co., Inc., Hackensack, N. J., in the newly created position of general manager. Hopkins has 25 years experience in industrial management. His prior experience includes executive vice president, Mallory-Schwartzkoft Metals Corp., and executive responsibilities in P. R. Mallory Co. and American Electro-Metal Corp. As general manager, Hopkins will be responsible for coordinating all corporate activities encompassing three manufacturing plants.

Newly elected members to the board of directors at Ultrasonic Industries, Inc., are SEYMOUR BERK, BERTRAM HARNETT, BERNARD KARDON and FREDERICK W. RICHMOND. They join HERBERT A. FRANKEL, HAROLD I. KAHEN, BARBARA A. JEWETT and PAUL M. PLATZMAN, who have been reelected for the coming year. A member of the New York Bar, Berk is a general insurance and reinsurance agent. Harnett is a partner in the New York City law firm of Poletti and Freidin. Kardon, a cofounder of Harman-Kardon, Inc., is currently director of engineering for Ultrasonics. Richard's numerous positions include president and chairman of the board of F. W. Richmond & Co., president of Walco Electronics Co. and chairman of the executive committee and a director of National Valve Mfg. Co.

Four additional directors have been elected to the board at Wyle Laboratories, El Segundo, Calif. They are DR. HAROLD E. EDGERTON, RICHARD W. JONES, ROBERT J. GARON and ELMER


# ARMSTRONG
## TOOL HOLDERS
### A Correct Tool for Every Lathe Operation



You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

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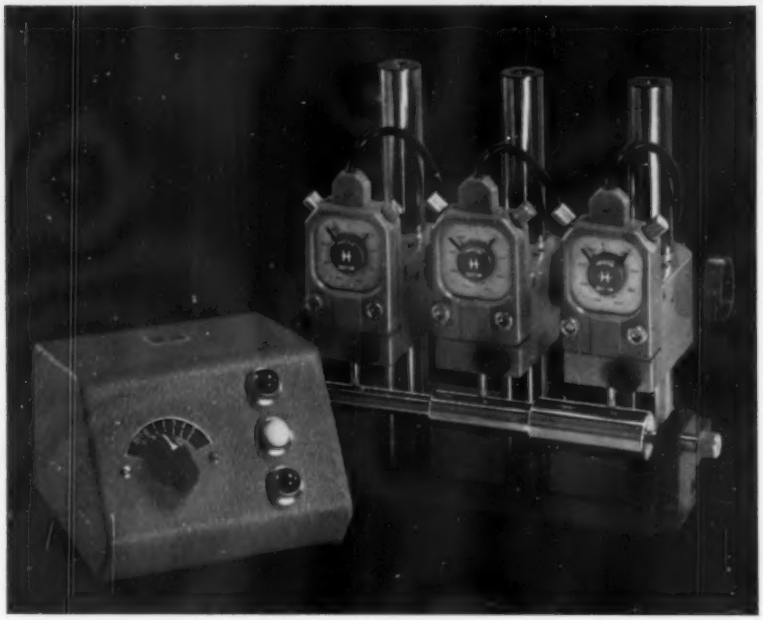
# New Hamilton electric gages control automatically to 0.0001"



## low cost multi-dimension gaging saves time, eliminates inspection errors

New, versatile Hamilton electric indicator gages provide faster, simpler and highly accurate gaging for semi-automatic or automatic post-process inspection, or in-process machine control. Operator error is eliminated by the use of lights which quickly and accurately indicate out-of-tolerance dimensions. Uniformly closer tolerances are assured. Inspection time is reduced by simultaneous measurement of all critical dimensions.

Hamilton electric gaging systems include electric indicators, gage holding fixtures and control units. For complete information on Hamilton electric and mechanical gages, write for Data File TE-5.

HAMILTON

WATCH COMPANY **Industrial Products Division**

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## Men at Work

R. EASTON. Dr. Edgerton is board chairman and vice president of Edgerton, Germeshausen & Grier, Inc., and a professor of electrical engineering at Massachusetts Institute of Technology. Jones is the managing partner of Mitchum, Jones & Templeton. Garon and Easton are, respectively, Wyle Laboratories' vice president and general manager and vice president in charge of field engineering and contracts.

**Rene C. McPherson**

RENE C. MCPHERSON (pictured) has been elected president of Hayes Steel Products, Ltd., a partially owned subsidiary of Dana Corp. Preceding his election, he was vice president of the company. McPherson served with the U. S. Air Force during World War II and graduated from Case Institute of Technology and Howard Graduate School of Business Administration.

JONATHON SMITH, former project manager of Sunbeam Equipment Corp., Meadville, Pa., has been appointed vice president of sales.

The board of directors of Oilgear Co., Milwaukee, Wis., has elevated ERNST WIEDMANN to vice president. Wiedmann graduated from Wuerttemberg State Technical College in Germany. He joined Oilgear in 1926.

RALPH F. GOW, who was elected president earlier this year of Norton Co., Worcester, Mass., has now been elected a director of Miniature Precision Bearings, Inc., of Keene, N. H. He replaces ARTHUR S. TORREY. Gow is also director of several Norton foreign plants.

ERIC H. RASK has been named manager of product engineering for Veeder-Root Inc., Hartford, Conn. He was most recently manager of shaver research and development at Sunbeam Corp., Chicago, Ill. Previously Rask had been with Remington Rand.


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# There's more to the buy than meets the eye

How do I know? We had a finish problem in reaming cast steel. Best finish we were getting was 150-175 micro-inch. We needed 60 or better. A W&B Service Engineer came in with one of their 1-1/16″ Chucking Reamers. He checked feeds and speeds—finally came up with .011 per revolution and 60 SFM. He recommended a secondary grind on the chamfer to assure clearance, then added a second chamfer of 67% . We were able to get and maintain a reamed finish of 40-50 micro-inches. At the end of the day, the operator was getting all good parts and saving substantial time per piece. In a case like ours, W&B's technical help, service and consistent reamer quality really convinced me that initial price is merely one factor. Find out for yourself . . . test W&B tools in *your* plant under *your* conditions. Call them in direct or through your industrial distributor. Do it today. See if *you* can't get better results.

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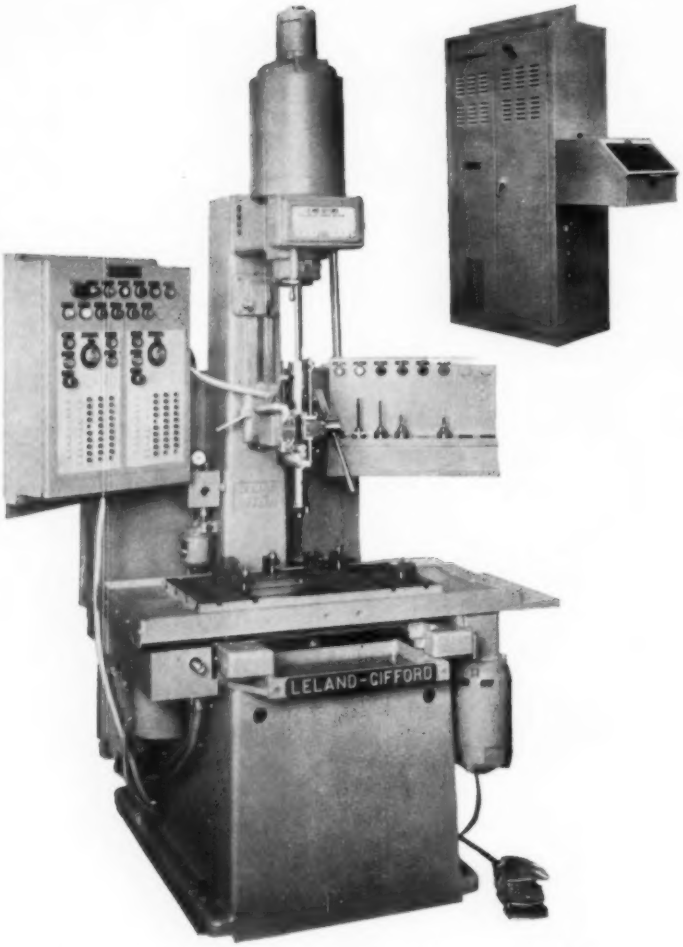
# TAPE CONTROLLED HOLE LOCATOR

*For General Purpose or Production Drilling*




This sensibly simplified, sophisticated layout drilling machine combines the best features of the proven Leland-Gifford HOLE LOCATOR and the universally accepted G. E. Mark II numerical positioning control.

For single part operation, simply punch the keyboard or dial coordinates on the console. For repetitive work, use standard eight channel punched tape. Program can include automatic reversal for tapping and instant stops for tool and speed changes as indicated by flash tool change lights.

Rugged table has precision machined locating blocks, tee slots and locating keyways which extend the work capacity beyond the table traverse.

Write for detailed information and proposal or ask to have an experienced sales engineer call.

## FEATURES

- Uses standard eight channel punched tape for production drilling.
- Single part operation by keyboard or dialing coordinates on console.
- Table traversed hydraulically on ball-bearing mounted and guided round ways.
- High speed positioning by self-contained, closed loop, hydraulic circuits and reversible G. E. Thy-Mo-Trol controlled motor driven pump.
- Highly accurate, sensitive precision ball-bearing spindle incorporates a zero float, quick change chuck.
- Six station turret depth stop plus 5″ traverse hand feed.
- Eight spindle speeds of 150/225/300/450/-600/900/1200/1800 or 150/300/450/-600/900/1200/1800/3600 RPM, using reversing motor and back gears.
- Nation-wide control service available from General Electric Co.

## SPECIFICATIONS*

| | |
|---|---|
| Table positioning speed | 200″ per minute |
| Positioning accuracy | ±.001″ non-accumulative |
| Repeatability | ±.0005″ |
| Table size | W.S. 28″ x 14″ |
| Table travel | 11″ front to back x 15″ left to right |
| Spindle overhang | 13″ |
| Spindle nose to table | 17″ Maximum 3″ Minimum |
| Capacity in cast iron | 7/8″ |
| Built-in coolant system | |
| Floor space | Machine 60″ x 50″ Control cabinet 62″ x 47″ |

**Subject to change. Dimensions are approximate.*

**LELAND-GIFFORD**

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# Field Notes

Results of a current study on abrasives machining are expected to show that machining of castings and cutoff of steel stock to final dimensions can be economically accomplished entirely with abrasives. Abrasive machining, in many cases, may prove more economical than the presently used cutter type machine tools. The study, a research project of the **Norton Co.**, is approaching abrasive machining from the standpoint of equipment required and economics involved. The first phase of the project is the correlation of available information from all sources. This information will determine the applications which seem promising for the second phase—mechanical research of equipment and techniques applying abrasive machining.

The Testing Machine Division, **Wiedmann Machine Co.**, King of Prussia, Pa., has been awarded a contract to engineer and design a special precision testing machine. The machine, an undertaking of the **National Bureau of Standards**, will be used to apply loads to high-capacity force-measuring devices, and to test materials and structures.

### acquisitions

Purchase of **Western Hydraulic and Service Co., Inc.**, by **Hathaway Instruments, Inc.**, of Denver has been announced. The purchase includes Western Hydraulic's "Tog-Loc" internal mechanical locking cylinder. Hathaway manufactures electromechanical and electronic systems and components for industrial, commercial and military use. The new acquisition will broaden Hathaway's manufacturing and marketing capabilities.

**Latrobe Steel Co.**, Latrobe, Pa., has purchased a majority interest in **Cast Masters Inc.**, Racine, Wis. Cast Masters specializes in producing large precision castings for the pattern making and tooling industries. The arrangement will combine Cast Masters' experience in pattern making and foundry techniques with Latrobe's broader metallurgical background.

**Richardson-Allen Corp.**, College Point, N. Y. is a new subsidiary of **Kollsman Instrument Corp.** The two companies will draw upon each other's resources and experience, while retaining independent operations. Kollsman, an established manufacturer of flight instruments, has been a ground-breaker in automatic celestial navigation systems.

**Scott Aviation Corp.**, Lancaster, N. Y., has announced the formation of **Ward Hydronics, Inc.**, as a wholly owned subsidiary. The new company has purchased all assets of Ward Tool and Machine Co., Alden, N. Y. Ward Hydronics will make and market special-purpose hydraulic cylinders.

**Ohio Forge & Machine Corp.**, Cleveland, Ohio, has acquired all outstanding shares of **Precision Cold Forged Products Co.**, Detroit, Mich., through an exchange of stock. Precision is engaged in cold forging, extrusion and upsetting of ferrous and nonferrous materials.

**Universal Match Corp.** has recently announced plans to purchase **Reflectone Electronics, Inc.**, Stamford, Conn. Reflectone designs and manufactures electronic and electromechanical systems for military and industrial applications.

**St. Mary's Mfg. Corp.**, North Tonowanda, N. Y., has announced the acquisition of the Special Tooling Division of **Pivot Punch and Die Corp.**, Tonowanda, N. Y.

**Conair, Inc.**, a supplier of instruments and controls for the aerospace industry, has been acquired by Richard B. Hubbard and Stanley O. Ruzicka. Conair—a specialist in electronic machining—produces parts from stellite, hastalloy, titanium and other exotic materials for aircraft, missile and space vehicle applications.

### association news

The **Industrial Diamond Association of America, Inc.** elected new officers and directors at its 16th annual meeting and convention. Officers elected to serve for the coming year were: Leopold H. Metzger, Super-Cut, Inc., president; Charles Baumgold, Diamond Tool Research Co., Inc., first vice president; and Eric J. Schneider, Engis Equipment Co., second vice president. Directors elected for the next two years will be: Irving Freed, Freed Industrial Diamond Corp.; Edward Katz, Diamond Drill Carbon Co.; and Leonard A. Zucker, Union Wire Die Corp.

The **Standards Engineers Society**, which promotes the study, discussion and application of all aspects of standardization, has installed its officers for 1961. The officers are: Harold R. Terhune, president; Kenneth W. Truhn, vice president; Robert F. Franciose, secretary; and Everett Woerter, treasurer.

The **Metal Powder Industries Federation** recently announced the election of the following companies to corporate membership in the In-Plant Powder Metallurgy Association: Purolator Products Inc., Rahway, N. J. and Clevite Corp., Mechanical Research Div., Cleveland, Ohio. The federation also announced new memberships in the Powder Metallurgy Parts Manufacturers Association. The companies elected were: Sintered Products Ltd., England; Baudier & Fils, and La Metallurgie Francaise des Poudres, France; and Sinterisa-Sinterizacao de Metais Ltda., Brazil.

The **Industrial Reactor Laboratories**, Plainsboro, N. J., formed by ten noncompeting industrial corporations, will be operated by **Columbia University** under Dr. Robert Wayne Houston as laboratory director. The laboratory was formed to supplement individual research efforts.

Ten awards of $1000 each have been announced by the **American Hot Dip Galvanizers Association** in cooperation with the American Zinc Institute. The awards, to be accompanied by appropriate medals and certificates of achievement, will be offered for ideas developing new applications and markets for hot dip galvanizing.

### awards

Lockheed Missile and Space Div., **Lockheed Aircraft Corp.**, Sunnydale, Calif., was recently awarded the Dr. Robert Hutchings Goddard Memorial Trophy for 1960. The award is for outstanding achievement in the missile and space field. Accomplishments of the Polaris and Discoverer programs resulted in the selection of Lockheed. Lockheed also received the Hoyt S. Vandenberg Trophy for 1960 for outstanding achievements in space science. This award is given by the Arnold Air Society.

Dr. Claude L. Clark, metallurgical engineer, Timken Roller Bearing Co., is the 26th winner of the Albert Sauveur

# NEW BROKEN TOOL DETECTOR

"Detect-A-Tool" is the new space saving solution to the problem of detecting tool breakage on automatic machine tools and transfer lines.

Expensive probe stations are eliminated as well as their attendant maintenance cost and floor space requirements, as the "Detect-A-Tool" is mounted on the work station itself.

Since the tools are checked each time they are used, tool failure is detected immediately and scrap losses from tool failures are eliminated.

"Detect-A-Tool" equipment can be easily installed on both old and new equipment. There are no complex moving parts to wear or get out of order, and little or no maintenance is required. Coolants, oils, or chips will not affect operation in any way.

"Detect-A-Tool" units are presently available for tools having effective diameters from 3/32" to 3/4".

This equipment features the same rugged construction and conservative electrical design that typifies all "MEK" products.

Complete "Detect-A-Tool" descriptive literature will be sent on request.

Manufacturers of

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- *Motor Control Centers*
- *Fabricated Electrical Enclosures*

**MEK**
Machinery Electrification, Inc.
60 Hudson St., Northboro, Mass.

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## Field Notes

Achievement Award of the **American Society for Metals.** The award is being made in recognition of Dr. Clark's outstanding achievements effecting advances in the knowledge of metalworking technology.

### expansions

**The Carborundum Co.,** Niagara Falls, N. Y., will construct a million-dollar manufacturing plant in Melbourne, Australia. The new plant, to be equipped with the most advanced facilities in the coated abrasive industry, is designed to meet the growing demand for coated abrasives in Australia and New Zealand.

**F. J. Stokes Corp.,** Philadelphia, Pa., has established F. J. Stokes Ltd., as a subsidiary company in Great Britain. The new company will manufacture and market Stoke's automatic plastics molding equipment and other high-speed automatic machinery.

### merger

Directors of **Midland-Ross Corp.,** and **Industrial Rayon Corp.,** both of Cleveland, Ohio, approved a merger of the companies. Industrial Rayon Corp., producers of rayon cord and textile rayon yarn, will operate as a division of Midland-Ross, manufacturers of products for various industries, including the aircraft and missile industries.

### moves

**Cast-Master,** a department of **Koehring Co.'s H-P-M division,** manufacturers of die casting machines, will move from its Bedford, Ohio, location to H-P-M facilities in Mt. Gilead, Ohio.

**General Vacuum Corp.,** formerly of East Boston, Mass., has moved to a new building at 81 Hicks Ave., Medford, Mass. The new plant, specially equipped for the design and manufacture of high-vacuum systems, has about 12,000 sq. ft of manufacturing, engineering and research space, and there is a planned expansion to double the area.

### name changes

**O'Neil-Irwin Mfg. Co.,** Lake City, Minn., has changed its name to **Di-Acro Corp.** The company believes the new name will give distinction to products produced under the Di-Acro trade name. O'Neil produces metalworking machines, punches and dies, and press brake dies.

**Jelrus Precision Casting Co.,** N. Y., N. Y., has assumed the name of its parent company, **Casting Engineers,**


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## Field Notes

Chicago, Ill. Sales headquarters for both companies are located in Chicago. Jelrus produces investment castings for the missile and electronics field.

**Lord Chemical and Equipment Div., Wheelabrator Corp.,** is the new name of the **Lord Chemical Corp.,** York, Pa. The Lord division will continue to manufacture precision finishing equipment, media and compounds in York and Red Lion, Pa.

### new companies

Negotiations have been concluded for formation of **Elliott-Litton Ltd.,** by **Litton Industries, Inc.,** Beverly Hills, Calif., and **Elliott-Automation** of England. The new firm will produce, distribute and sell electron tubes developed by Litton and by Elliott's microwave tube operations.

A group of men interested and experienced in heat treating or plating services have established a new company, **Rex of Florida, Inc.** Principals involved in this new operation are: J. Walter Rex, president; C. E. Harington, vice president; Orrin G. Meyers, secretary; and G. Clayton Rex, treasurer. Rex of Florida, Inc., will operate as a subsidiary of J. W. Rex Co., of Lansdale, Pa.

### new activities

**Deltronic Corp.,** Costa Mesa, Calif., has announced that a contract has been signed with **MetroLonics, Inc.,** Los Angeles, Calif., an independent testing laboratory, to provide quality control surveillance and production-run sampling of all Deltronic cylindrical plug gages. In addition to the weekly reports on production, monthly inspection will be made of production and inspection facilities and personnel.

Establishment of **Thor Electronics Tooling Div.** has been announced by **Thor Power Tool Co.,** Aurora, Ill. The new division will develop products for the manufacturers of electronic equipment.

An agreement has been made between **Steel Improvement and Forge Co.,** Cleveland and **Ex-Cell-O Corp.,** Detroit, whereby Ex-Cell-O has been granted exclusive rights to build and market metalworking machines using Steel Improvement's electrochemical processes in the United States and Canada. Steel Improvement will make and market electrolytic solutions used in the metal-removing method and will continue research and development involved in the chemical processes.


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## Field Notes

**The Martin Co.** has awarded a multi-million dollar contract to **Hughes Aircraft Co.**, Culver City, Calif., for technical assistance in activating an Air Force Titan ICBM base at Mountain Home, Idaho. The Idaho facility is one of nine Titan bases being activated by Martin for the Air Force's Strategic Air Command.

### new facilities

**Ultrasonics Div. of Blackstone Corp.,** Jamestown, N. Y., has announced expansion of its research, development and production facilities. The expansion, announced concurrently with a disclosure of organizational changes is expected to broaden the company's position in the field of sonic energy.

**Tinsley Laboratories, Inc.,** designers and manufacturers of telescopes and optical systems, has moved to its new plant and office building in Berkeley, Calif. Included in construction of the building is an 80-ft. tunnel which will be used for checking focal lengths of mirrors and lenses. Also included is a retractable roof section which can be rolled back for the testing of astronomical telescopes.

Construction of a new $2,500,000 plant for **Reed Instrument Bearing Co.** has begun in Los Angeles. Reed—a division of **SKF Industries, Inc.**—is a major supplier to the missile, aircraft and related instrumentation fields. Its miniature bearings are used in gyrocompass, computer, potentiometer, gear train, and miniature motor and tape recorder applications.

**Crucible Steel Co. of America** has announced near-completion of the new plant of **Magnatronic, Inc.,** a wholly owned subsidiary. The new facility is intended for production of ceramic permanent magnets for the electronic industry.

**Titanium Metals Corp. of America** has announced a two-million dollar expansion program for its Toronto, Ohio plant. Included in the program is construction of new facilities for producing titanium tubing. The new plant will enable TMCA to reduce greatly the lead time required for quantity production of tubing products.

**Sharon Steel Corp.,** Sharon, Pa., has started construction of a new vacuum stream droplet degassing unit for production of high-quality forging steel. Scheduled for production within six months, the unit will be Sharon's second major installation undertaken in 1961.

# TOOL ENGINEERING in Europe

## Machining of Graphite

The ever-changing manufacturing problems resulting from the development of science and industry are well illustrated by an article discussing the machining of synthetic graphite, which is used in large quantities in atomic reactors. The article, by H. Stubbs, appears in *Werkstattstechnik*, Vol. 51, No. 1, 1961, p. 16-22, under the title "Die Bearbeitung von Graphit fuer Atomreaktoren."

The paper is based on the author's experience during the past ten years in a shop where graphite for atomic reactors has been machined for the European continent and the British Atomic Energy Authority. Only synthetic graphite distilled from crude oil can be used in atomic reactors because natural graphite includes too many foreign elements which cannot be extracted at reasonable cost.

Synthetic graphite, which is actually very pure carbon, abrades the tools considerably. Cutting fluids must not be used, since they would contaminate the graphite.

Approximately 60,000 graphite parts are required for an atomic reactor. They often have the same or similar dimensions, rendering it possible to machine them on transfer type machines and setups. The raw material is delivered to the machine shop mostly in the form of 9 x 32-inch blocks weighing approximately 140 lb. The compressive strength is high, while shear strength and elongation are low. The structure of synthetic graphite is similar to that of cast iron and is divided into two classes, A and B. Class A graphite is used for the inner parts of the reactor; Class B, for the outer parts.

The machining process must be carried out in such a way that the graphite is not contaminated by copper, brass, lead and (particularly) oil and water. This condition must be complied with very strictly. Milling cutters must be resharpened dry because experience has shown that it is difficult to remove the last few drops of coolant. Leather gloves must be used by everyone coming into contact with the workpieces, tools, instruments and so on. No other material can be machined in the same department of the shop. Hammers made of nonferrous metals are not allowed, only steel hammers which do not chip, and this applies even to the toolroom.

Machining is mostly done by milling, although drilling and turning operations are carried out also. Fixtures must be so designed that the cutting force is directed toward the housing or frame but not toward a movable part. They must be rigid and ample chip space must be provided. Clamps must have large surfaces in order to reduce the pressure per unit area exerted on the graphite.

An illustration in the article shows the setup of a transfer line beginning with a bandsaw running at 1500 fpm, followed by a double-spindle bed type milling machine cutting at 1120 fpm with a milling cutter having 20 high-speed steel teeth and operating at a feed rate of 100 ipm. The third machine—out of a total of seven—performs the same operation as the second machine, on the opposite work surface. A special drilling machine is used for boring and counterboring at 630-fpm surface speed and a feed rate of 310 ipm. The remaining machines perform the milling of a radius (915-fpm cutting speed) and similar operations, including spline milling. The workpieces are inspected between all operations.

Sixty-five "runs" represents the tool life of a milling cutter expressed in terms of satisfactory surface finish. During the last five runs the surface begins to deteriorate rather suddenly until it is no longer acceptable after 65 runs. It can be computed from other data given in the article that a run corresponds to machining at a feed rate of about 100 ipm, a depth of cut of approximately ¾ inch and a cutting speed of 1120 fpm. The author does not recommend running a cutter at less than 350 rpm because of the heavy wear and chipping of the graphite at high speeds. Tool life was reduced to 35 runs when the feed rate was reduced to about 40 ipm. The tool geometry of the cutters is also discussed in the article.

As far as drilling and boring is concerned, the author recommends vertical machines, because they permit easier chip removal than horizontal machines. The hot chips must be removed fast in order to avoid expansion and out-of-round holes. Turret lathes or automatic screw machines are used for turning and threading operation of a multitude of small graphite parts. Threading is a very difficult operation; the depth of cut should not be less than 0.005 inch and the cutting speed not less than 630 fpm. Workpieces of synthetic graphite as large as 20 inches in diameter and weighing 250 lb are turned in special fixtures using three tools arranged in a circle.

A section of the article deals with exhaust systems for chip or dust removal. The air velocity should be about 6000 cu ft/min, which can be obtained by exhaust fans running at 2000 rpm at a capacity of 6500 cu ft/min. The attachments connecting the machine tools with the exhaust line are fully described.

Scrap produced in a machining operation can often be re-used for a smaller part because of the geometrical similarity of many parts. The author indicates, however, that the design trend is toward more complex parts which may be more difficult to machine, requiring new and different machine tools.

## Machine Tool Colors

Optimum working conditions in a machine shop depend not only on light, temperature, humidity, hygiene and safety, but also on the colors of the machine tools the operators are working with, according to an article by H. Frieling in *T. Z. fuer praktische Mettallbearbeitung*, Vol. 55, No. 1, 1961, p. 39-41. The article is entitled "Farbge = bung am Arbeitsplatz und an Werkzeugmaschinen."

Frieling points out that improvements in production can be attained by taking into account the psychological effects of color, reflection and intensity of illumination in the machine shop and suggests that these effects should be more thoroughly analyzed than has usually been the case in industry. In particular, he recommends using colors that have a favorable psychological effect on the men who operate the machines.

Green cannot be an ideal color for all machine tools, says Frieling. Other colors should be taken into consideration. They should be selected from a punched color card which permits estimating the reflection factor when the machine is painted a specific color. The intensity of reflection can be computed by means of a simple formula given in the article, which describes a "reflection factor." This factor should not be smaller than 0.15 and not larger than 0.30. Pure white is assigned the factor 1.0.

Colors affect the sales appeal of a machine to a considerable extent. Frieling thinks that this aspect of the problem has not been given sufficient attention and that it should be investigated by experts. He also discusses color contrasts, mixed colors, and special colors for sales appeal and safety. While yellow would be acceptable in

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## Tool Engineering in Europe

many cases for a safety valve or a lever, it would be irritating when used on a fast-moving machine part such as the ram of a shaper. Background effects when showing machine tools at an exposition are also discussed.

### Overloaded Drives

The load exerted on a machine tool drive during start often reaches four to five times the nominal load of the motor and even up to 15 times when a machine tool is stopped. This is the opinion of E. I. Rivin, writing in *Stanki i Instrument*. His article is translated into English in *Machines and Tooling*, Vol. 31, No. 9. The title of the article is "Calculating Overloads in Machine Tool Drives During Starting and Stopping." Repeated overloading of this type causes premature failure of clutches, gears and other machine elements. The article gives a method for evaluating the maximum torque at the drive shaft of the headstock, taking various methods of stop and start into consideration. Suggestions for reducing overloading are also given.

Starting a machine equipped with an asynchronous motor produces a pulsating electromagnetic moment on the mechanical system. Its magnitude depends upon the frequency of the electromagnetic oscillation and on the natural frequency of torsional vibration of the headstock drive. The author develops a series of mathematical equations covering this phenomenon and suggests that the natural frequency of vibration of the drive system must first be computed and then the mass moment of inertia of the combined (motor and drive) system, leading to the natural frequency of the entire drive. The next step is the computation of the actual amplitude for various values of "cos $\tau$" of the electric current. The method is explained by an example for a knee type milling machine and for a bench type lathe. Both examples were checked experimentally, taking oscillographs which showed that the maximum torque reached four times the nominal torque as calculated.

The effect of acceleration on the generation of self-excited vibrations is likewise discussed in detail. Such vibrations may be set up as a result of transient electromagnetic moments in the motor. They are rapidly damped when the operating conditions correspond to the stable characteristics of the system, but build up (i.e., are self-excited) when the operation occurs within the unstable region. The main conclusions follow:

1. An elastic clutch reduces the frequency of vibration and also the load,


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for transient processes. Such a clutch also reduces the likelihood of self-excited vibration in the starting of the motor.

2. The time of acceleration is reduced by reducing the moment of inertia of the drive.

3. A friction clutch should not be used in cases where the feed drive is supplied by a separate motor, since the cutting force may suddenly increase when the clutch is slipping due to vibration, which will lead to further slipping and breakdown of the tool.

4. To remove self-excited vibration during acceleration, motors with high starting torque are recommended.

5. To reduce dynamic loads when stopping and starting, motors with synchronous speeds of about 3000 rpm should be used.

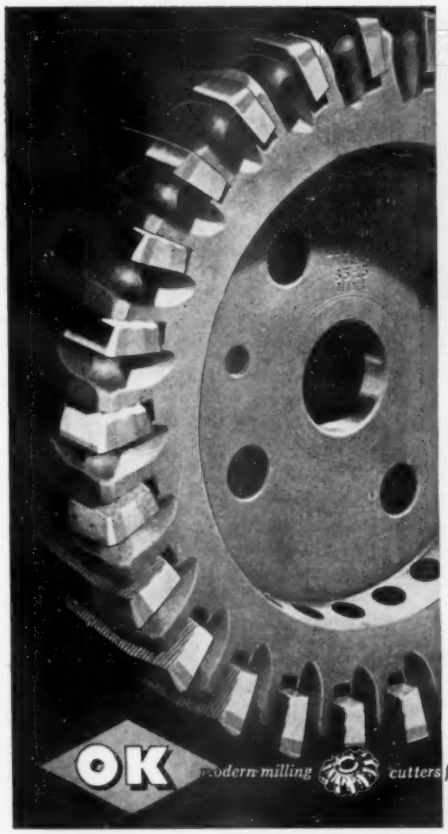
### Environment and Productivity

A good article dealing with the psychological effects of the environment on working efficiency appears in *Industrielle Organisation*, Vol. 29, No. 10, 1960, p. 419-424. The title of the article, which is by H. Schnewling, is "Arbeitsplatz Gestaltung in der Maschinenindustrie."

The author's investigations cover dynamic and static loads on the worker, the motions required in the execution of an operation (location, type, number and direction), visual considerations, and factors in the environment that may promote or disturb the work.

Static loads should be eliminated due to the worker fatigue caused by standing for a long time and frequent bending. The energy consumption is only four percent higher when sitting than when lying down but increases to 12 percent when standing up and to 55 percent when bending. Suggestions for improving working conditions involve stool height, chair design, arrangements of tools, mechanical aids, and rules for the manufacturing engineer, such as arranging operations in such a way that both hands begin and finish the motions simultaneously.

It is also advisable, says Schnewling, to plan motions of the hands in opposite directions, thus distributing the load evenly to both hands. This, however, is not necessarily true for all working conditions. Examples discussed by the author include operation of a mechanical screwdriver, winding of induction coils, assembly of electrical elements on rolling fixtures (which can be tilted to eliminate strain on the back of the operator), cutting corners on magnets with pneumatic tools and assembly of transistors.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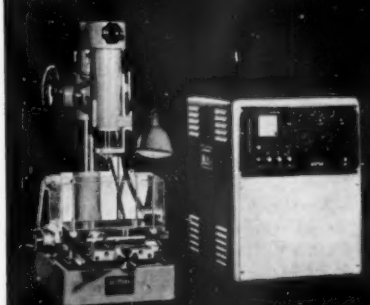

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# Engineering Bookshelf

DIE ARBEITSZEIT ERMITTLUNG DER VERZAHNUNGSARBEITEN. *Von Dr. Ing. W. Bueltmann, Springer Verlag, Berlin/Goettingen/-Heidelberg/ 1960, 175 pages.*

This book covers the entire field of time studies for spur, helical, bevel, worm and other gear-cutting operations, the first book ever written exclusively on this subject. The six chapters adequately cover the topics of gear milling, hobbing, shaping, shaving and grinding.

The manufacture of gears and particularly the rate setting for these operations requires good knowledge of the principles of metalcutting science and familiarity with the design features of gears. Time-study men and tool engineers will find many answers to their problems in this book. Examples for rate-setting methods are given including some mathematical formulas essential to the rate setter. The most important gear-cutting machines of American and European design—such as those machines made by Maag, Fellows, Orcutt, Schaudt, Churchill, Reishauer, Gleason, Niles and Oerlikon—are described.

The book can be recommended to those familiar with German engineering terms and acquainted with the Modul System used in metric countries for dimensioning of gears rather than the Pitch System used by us.

*Dr. M. Kronenberg*
*Consulting Engineer*
*Cincinnati 6, Ohio*

MACHINING CHARACTERISTICS OF HIGH STRENGTH THERMAL RESISTANT MATERIALS —VOLUME 4—*Test work at Metcut Research Associates, Inc. Directed and published by Curtiss-Wright Corp., Woodridge, N. J. Price $4.60. 181 pages.*

As part of the Air Material Command's Manufacturing Methods Div.'s program to increase producibility and improve quality and efficiency of fabrication of space-age components, considerable manufacturing research has been done. This volume, fourth in a series on machining characteristics of metals important to the aircraft and missile industry, is well-printed, well-illustrated and sturdily bound. A great deal of usable information is ably presented.

The study covers machining characteristics (turning, milling, drilling, tapping) for 25 high-strength, thermal-resistant alloys. Relationships are presented between tool life, cutting speed, feed, tool geometry, tool material and cutting fluids. The effects of grinding conditions are indicated for six typical high-strength, thermal-resistant alloys. Increased requirements are described for precise control of rigidity, speeds, feeds, and tool geometry for machine tools to be properly capable of machining these alloys.

AWS DEFINITIONS, WELDING AND CUTTING —*Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. $2. 59 pages.*

In addition to providing a complete dictionary of welding terms, this book defines the Society's standards for welding and flame cutting. Included are line drawings of all the established types of welds plus the part geometry required to effect them. Flame geometry and application are also discussed clearly and in detail.

CONTEMPORARY PROBLEMS OF METALLURGY —*Edited by A. M. Samarin. Published by Consultants Bureau Enterprises, Inc., 227 W. 17th St., New York 11, N. Y. Price $16. 227 pages.*

Metallurgical techniques and problems in the Soviet Union and its Satellites are treated in this text. In discussing engineering and science, the book appears useful and informative but, like most Soviet literature, it is heavily seasoned with political asides. Throughout the book, the October Revolution is treated not only as a political event of cataclysmic importance but as a point in time from which stems the chronological beginning of Soviet science. Presumably, it marks the beginning of all true science, since it is inferred by the book that Soviet science and technology are infinitely superior to that of the Western Democracies.

Major topics covered in this book are raw materials and fuels in the USSR, metallurgy of nonferrous metals, working of metals by pressure and the science of metals. Most of the information is either basic or applicable to metallurgical problems peculiar to the Soviet Union.

Principal value of this book is the insight it provides American metallurgists with their Russian counterparts. Quite obviously these are a hybrid breed, well-read in Marx and Engles, and capable of focusing one eye on a grain structure from a fractured rail and the other on the nearest commissar.

THEORY OF METALCUTTING—*By Paul H. Black. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $17.50 204 pages.*

Directed toward fostering an understanding of the metalcutting process, the treatment in this book is fundamental. Principles of metal cutting are explained in a manner compatible with the basic theories, avoiding the complexities of a rigorous treatment. Although the mechanism of chip removal is complex, a step-by-step consideration of the elements of the process provides a good basis of understanding. Quantitative data are supplied to assist in establishing metalcutting specifications. The text is well organized, amply referenced and helpful both in teaching metalcutting and in specifying machining operations.

NONDESTRUCTIVE TESTING—*By Warren J. McGonnagle. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $15.00. 455 pages.*

Just as the fruit vendor can judge the ripeness of his watermelon by thumping it with his thumb, or his cantaloupe by shaking it and listening for the rattle of the loose seeds, the manufacturer can inspect the quality of his material by using nondestructive test methods. From the industrial point of view, the purpose of nondestructive testing is to determine, without impairing future usefulness, whether a material or part will satisfactorily perform its intended function.

This book brings together both the practical methods in use today and the scientific principles upon which they are based. Written to help orient the beginning student and technician in the field, it contains a wealth of information covering visual testing, pressure and leak testing, liquid penetrant inspection, thermal methods and dynamic testing. Thickness measurement, X-ray and gamma radiography, ultrasonics and magnetic, electric and eddy currents—these also are categorical methods given extensive treatment. In treating the field as a technology based on applied physics, special attention is placed on work in the area of atomic energy.

The methods and techniques used in nondestructive testing not only detect and locate flaws; they also measure physical properties or inhomogeneities in physical properties. Although most tests are simple in principle, the choice of method, the techniques used and the interpretation of results require skill and experience. For this reason, the author adds the finishing touch to his work by providing more than 60 tables of helpful engineering data.

DICTIONARY OF MECHANICAL ENGINEERING—*By Alfred Del Vecchio. Published by Philosophical Library, Inc., 15 E. 40th St., New York, N. Y. Price $6.*

Starting with "abrasives" and ending with "zones," this book presents clear and concise definitions of almost all terminology currently used in mechanical engineering. In addition to engineering words and terminology, many words from the architect's lexicon are also included. This book should be useful to practicing engineers and engineering students.

INTRODUCTION TO THE KINEMATIC GEOMETRY OF GEAR TEETH—*By Allan H. Candee. Published by Chilton Co., 56th and Chestnut St., Philadelphia 39, Pa. Price $12.50. 204 pages.*

Scope of this book is restricted to gears on parallel axes with straight teeth parallel to the axes. The basic problem concerns contact between tooth profiles in a plane and all related problems can be solved by two-dimensional plane geometry and Kinematic geometry. Tooth generation and tooth design are treated as important parts of gear design. The important feature of the book is the method in which problems are treated. None of the problems treated is new, but solutions are obtained by thinking in terms of geometry instead of the more abstract mathematical concepts. As such this book is certain to have a wide appeal to the practical-minded tool engineer.

YEAR BOOK OF THE AMERICAN BUREAU OF METAL STATISTICS—*Published by the American Bureau of Metal Statistics, 50 Broadway, New York 4, N. Y. Price $4.50. 139 pages.*

This book presents an almost complete statistical coverage of the origin, production and consumption of nonferrous metals in the United States, and other countries of the Free World. Also included are detailed analyses of the chemical composition of many of these materials.

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NEW POLYMERS—NEW PROBLEMS—*By Herman F. Mark. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price $1. 8 pages.*

Presented originally as an Edgar Marburg Lecture, this booklet discusses current problems and properties of some of the new polymers. Tables showing properties of strength, elongation, specific gravity and energies of cohesion accompany the text. This booklet will prove interesting and informative to engineers in the fiber, rubber, plastics, coating and adhesive industries.

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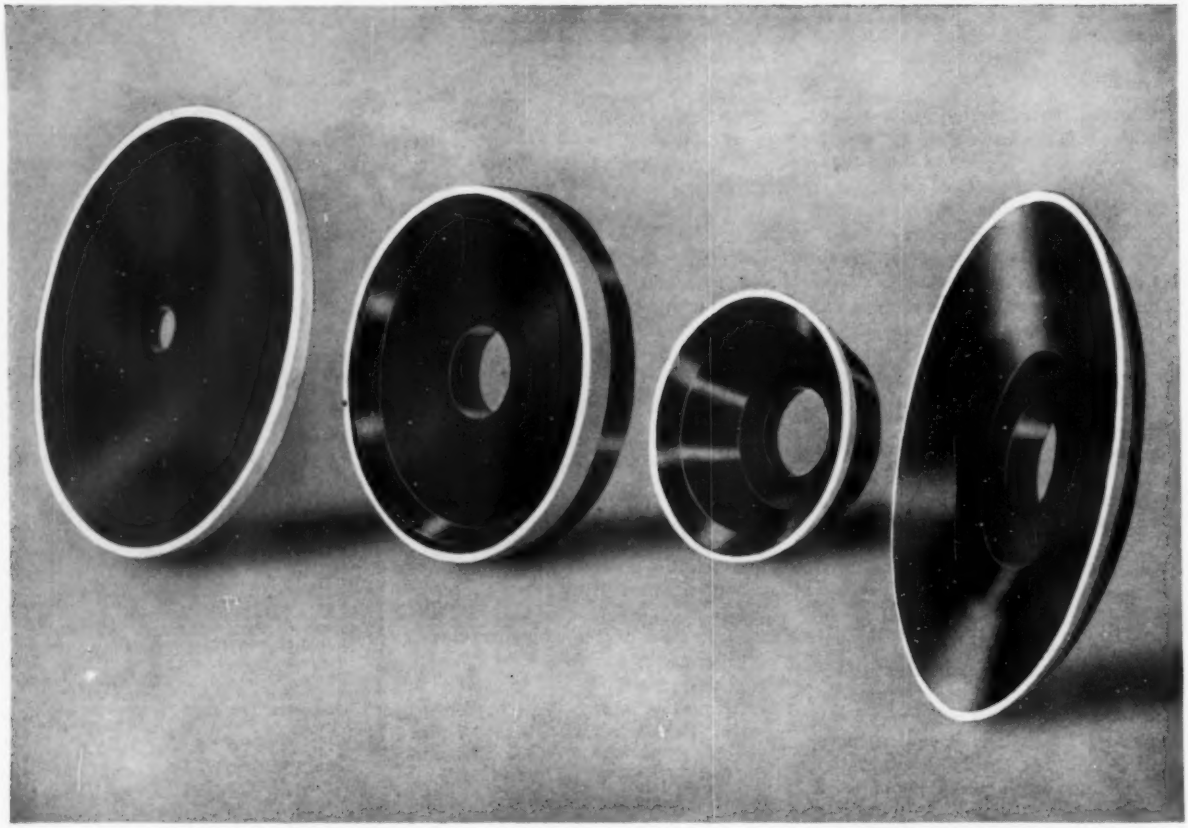

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Manhattan Diamond Wheels are engineered to give you faster, cooler cutting and longer life.

Advancements in Diamond Wheel construction and NEW RESINOID BOND developments fully utilize the advantages of both man-made and natural diamond insuring top performance from all Manhattan Diamond Wheels.

TRY Manhattan Diamond Wheels on your toughest application—find out for yourself how they perform in your plant—under your conditions—on your operation.

- New Bonds
- Longer Life
- Bonded for Specific Grinding Requirements
- Natural or Man-made Diamonds

*"MORE USE PER DOLLAR"*

RM1081

ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

RM

*WRITE TO DIAMOND WHEEL DEPARTMENT*

**MANHATTAN RUBBER DIVISION—PASSAIC, N.J.**

***RAYBESTOS-MANHATTAN, INC.***

# technical shorts

**Nylon Abrasive Wheel**—Using an abrasive wheel of nonwoven nylon, Jarco Metal Products Corp. is producing lipstick cases with a spiral scratch pattern. When silver plated, the cases have a soft matte finish which, besides being pleasing to look at and touch, resists slipping from the fingers.

The cases are brought into successive contact with two coated abrasive belts which clean up the surface and then with the Bear-Tex wheel recently developed by Behr-Manning Co. Belts are of 100 and 280-grit aluminum oxide abrasive bonded by all-resin adhesive to X-weight cloth backings. They run at 4000 fpm over serrated rubber contact wheels of medium hardness.

The 3 x 14-inch-diam wheel which produces the scratch pattern has fine silicon carbide grit dispersed throughout its thickness, so that its performance remains constant as wear occurs. The natural resiliency of the nylon wheel allows it to conform to the shape of the cases. All three abrasive heads are so tilted that the lipstick cases get a downward sweep as they pass.

**Sand Coating Process**—A new process for coating sand particles with a thermosetting phenolic resin, developed by Durez Plastics Div., Hooker Chemical Corp., increases the simplicity and efficiency of producing shell molds and cores. It involves mixing sand, powdered resin, alcohol and water in controlled proportions or a predissolved solid resin in a mixture of alcohol and water.

The alcohol serves as a solvent for the resin, resulting in a liquid that thoroughly coats each particle of sand in the mixing process. The water reduces explosion and fire hazards, speeds up the solvent evaporation rate and decreases the packing tendencies of dry coated sand.

The entire process, using no chemical activity, can be conducted cold or accelerated with hot air. It solves a major problem of mixing dry sand and resin in that it keeps the two from segregating. Resin-coated sands provide faster production, dust-free operation, uniform structure, lower cost and minimum mold lubrication.

**Elevated Temperature Bars**—Two high-strength alloy steel bars offer new opportunities for improvements in the design of parts. The materials, known as e.t.d. 150 and e.t.d. 180 are 0.40 minimum carbon alloy steel bars made by the LaSalle Steel Co. elevated-temperature drawing process.

In this process, the steel bar is drawn at temperatures significantly above room temperature but below the lower critical temperature. Because each bar is individually processed, exceptional uniformity and control of properties are achieved.

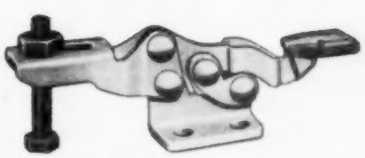
These alloys take the place of quenched and tempered bar steels and eliminate heat-treating and costly secondary operations. The first of the two has a tensile strength of 150,000 psi and Rc 32 hardness. A still higher strength level is offered by the second which has a tensile strength of 180,000 psi and a hardness of Rc 38.


## MINIATURE KNU-VISE CLAMPS DO MIGHTY JOBS

**These tiny Knu-Vise toggle clamps are capable of exerting 100 to 150 Lbs. clamping force with a reach of 7/8 and 9/16 inch respectively in front of base. Other features are:**

- **Clamping height, 19/32 above base.**
- **Double shear bearing pins prevent clamping spindle side-thrust or tilt.**
- **Largest diameter pins for size of clamp—80% minimum bearing area.**
- **When open, spindle head withdraws beyond front of base, permits vertical removal of largest parts.**
- **All models have replaceable grips.**

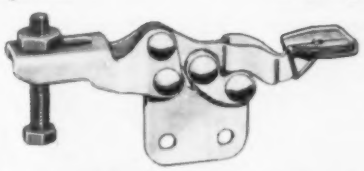
**Four Models H-100 Twin-flange base**



**HL-100 Left-flange base**

**HR-100 Right-flange base**

**SH-100 Straight base for side mounting.**



**All shown 3/4 actual size**

**Write—TODAY, to Dept. A—for complete information.**

**Manufacturers of over 150 models of manually and air-operated clamps and pliers**

**KNU-VISE PRODUCTS** **LAPEER MANUFACTURING CO.**

**3053 DAVISON ROAD**
**LAPEER, MICHIGAN**

WESTERN DIV.: PECK and LEWIS CORPORATION
4436 Long Beach Ave., Los Angeles 58, Calif., ADams 3-7146

CANADIAN DIV.: HIGGINSON EQUIP. SALES LTD.
1131 Pettit Road, Burlington, Ontario

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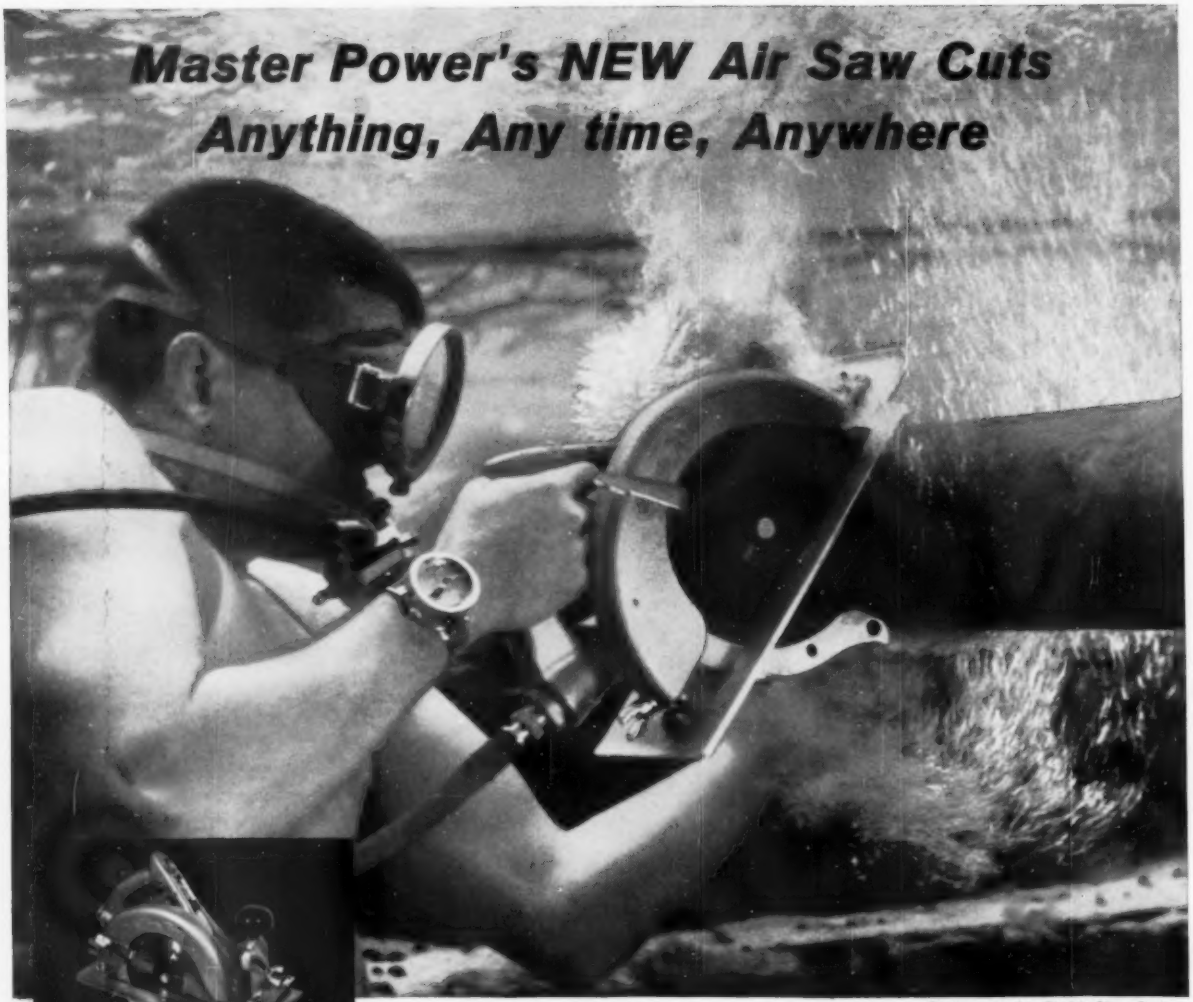
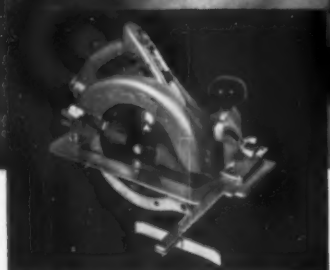
# Master Power's NEW Air Saw Cuts Anything, Any time, Anywhere



Photographed at Florida Silver Springs



**12 WAYS BETTER than any portable saw you ever used...**

- No gears.
- No windings, no stators, no shock factor, no deterioration.
- Lighter weight, compact.
- Fully adjustable to 2-11/16" depth of cut; 2" for 45° angle cuts.
- Safer—no coasting on shut-off; no loading up of saw teeth.
- Quiet in operation—loudest noise is the cutting.
- Controlled direction of exhaust to muffler or to blade for cooling.
- Governor controlled for safety—no burn out in event of stall.
- Low weight vs. horsepower ratio—6000 rpm.
- Big 8¼" diameter combination blade.
- Easily dismantled for service.
- Totally enclosed air motor with over 14 years of proven field use.

Use it on your toughest cutting jobs—the proof is in the performance! This #408 portable air saw is the latest addition to the Master Power line of precision-built, quality air tools. Not only will this lightweight, easy-to-handle tool out-perform anything you've ever used before, but also it brings you safety advantages no other portable saw can offer: little coasting on shut-off; no loading up of saw teeth; no shock factor; no deterioration; to name a few. (Not that you'll ever have to, but you can even use it under water!)

The new Master Power #408 cuts most anything—sheet steel, corrugated roofing, channel iron, bar stock, wood, aluminum, cast iron, and more. Comes complete with carrying case and rip fence. Mail coupon for a free demonstration or additional information. *Leading distributors everywhere.*

Leading distributors everywhere sell

**MP Master Power**

A **Black & Decker** Subsidiary

LOOK UNDER TOOLS—PNEUMATIC

MASTER POWER CORPORATION, Dept. A-051, Solon, Ohio

☐ Free demonstration ☐ Added information

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Company.....

Address.....

City.....Zone.....State.....

In Canada: MASTER PNEUMATIC TOOLS (CANADA) LTD., REXDALE-TORONTO, ONTARIO

# Trade Literature

*for free booklets and catalogs—use request card, page 213*

ILLUSTRATED BOOKLET describes the instant mechanical retrieval of engineering drawings on Filmsort aperture cards from a file of over two million drawings. Time and dollar savings are stressed. Microfilm Products, Minnesota Mining and Manufacturing Co. **(Circle 701)** . . . Principal existing and potential uses of piezoelectricity are covered in a 16-page booklet. Piezoelectric devices, which convert electrical energy to mechanical energy and the reverse, are used in ultrasonic testing, machining and cleaning. Clevite Electronic Components. **(Circle 702)** . . . Extensive catalog covers complete line of toolholders, milling cutters, locking wedges and special tooling. Greenleaf Corp. **(Circle 703)**

### Automation, Mechanization

Numerical control as applied to the complete integration of product testing with a manufacturing business is the subject of a paper written by W. S. Bennett and delivered at the ASTME Seminar, "Automation and Numerical Control." Designers for Industry, Inc. **(Circle 704)** . . . One of the largest and most diversified numerical control installations in the industry is described in a 28-page book. Republic Aviation Corp. **(Circle 705)** . . . An information bulletin on digital supervisory control and telemetry systems covers the broad subject of automatic remote control and describes five specific systems applications. Moore Associates, Inc. **(Circle 706)** . . . Bulletin illustrates engineered production with numerically controlled machine tools. Sundstrand Machine Tool Div. of Sundstrand Corp. **(Circle 707)** . . . Catalog, "Counting Instruments for Industrial Production," presents all models needed to meet ordinary industrial requirements. Durant Mfg. Co. **(Circle 708)** . . . Twenty-page catalog presents a representative selection of products from the Micro Switch line of precision switches. Micro Switch Div., Minneapolis-Honeywell Regulator Co. **(Circle 709)** . . . Reference manual for the application of automatic weighing, sensing systems shows how the principle of weight sensing or measurement of force can be utilized to perform a variety of production and quality control functions. The Exact Weight Scale Co. **(Circle 710)** . . . What a trolley conveyor can do to reduce manufacturing costs, and selection of the right trolley conveyors for specific requirements, are topics covered in a 58-page book. Link-Belt Co. **(Circle 711)** . . . Catalog, "Counting Instruments," covers electric, stroke, turn, revolution and coil winding counters; also counter actuators. Automation Controls Div., General Controls Co. **(Circle 712)** . . . Containing over 100 illustrations, a 46-page catalog section covers a line of electromagnetically vibrated feeders. Syntron Co. **(Circle 713)** . . . Modular belt conveyors for bench operations, both fixed and variable speed, are described in a bulletin. Products for Industry, Inc. **(Circle 714)** . . . Building block units are explained in a brochure. New specialized machines, automated equipment, conversions of existing planer, milling and drilling equipment are described. S & S Machinery Co. **(Circle 715)** . . . Line of externally adjustable pressure and differential switches is covered in a bulletin, which shows applications to industrial fluid systems. Pall Corp. **(Circle 716)**

### Bending

Radius blocks for bending radii in conduit and fluid line tubing according to Military Standard MS 33611, and associated tube bending equipment, are covered in a catalog. Parker-Hannifin Corp. **(Circle 717)** . . . Bending press bulletin discusses eight models ranging from one for 1-inch OD by 0.065-inch wall steel tubing to one for 3½-inch OD by 0.125-inch wall steel tubing. Pines Engineering Co., Inc. **(Circle 718)**

### Boring, Drilling, Tapping

Drilling tools for holes from 0.001 to 0.375 inch are described in a catalog. The Dumore Co. **(Circle 719)** . . . New pipe tap produces improved threads. Besley-Welles Corp. **(Circle 720)** . . . Catalog covers drill pointing and engineering data, plus high-speed steel, carbide-tipped, and solid carbide drills, and drills for hard steel and special twist drills. American Twist Drills **(Circle 721)** . . . Bulletin covers the Fosmatic numerically controlled turret drill that has thirty-two spindles in a revolving turret. Fosdick Machine Tool Co. **(Circle 722)** . . . Bulletin describes stationary and rotary valve taps. Landis Machine Co. **(Circle 723)** . . . Thirty-six page tap selector lists 1200 different sizes and types of standard taps. The Hanson-Whitney Co. **(Circle 724)** . . . Ground-from-the-solid process for producing high-speed steel drills is illustrated, and a variety of drills is described. Ace Drill Corp. **(Circle 725)**

### Chucks and Vises

Chuck and collet actuators, described as nonrotating air cylinders with a large center hole, used to operate air and collet chucks, are described in a folder. Power Grip, Inc. **(Circle 726)** . . . Three styles of air chucks for work or toolholding in rotating or nonrotating applications are covered in a bulletin. Erickson Tool Co. **(Circle 727)** . . . Data sheet describes a new precision grinding vise. The Producto Machine Co. **(Circle 728)**

### Cleaning, Painting, Plating

A new solvent is especially useful for spot-free drying of intricately shaped parts with cracks or crevices after electroplating, phosphating, chromating, electropolishing, contour etching, acid pickling, bright dipping and alkaline derusting. Phillips Mfg. Co., Inc. **(Circle 729)** . . . Brochure illustrates the types of masks available for rapid multiple color wet painting of mass produced parts. Conforming Matrix Corp. **(Circle 730)** . . . Brochure contains facts on centrifugal tinning processes and equipment. The Leon J. Barrett Co. **(Circle 731)** . . . Booklet on selective plating describes a new high-speed process. A chart giving deposition rates, metal concentrations and recommended current densities is included. Selectrons, Ltd. **(Circle 732)** . . . Major plating barrel specifications

## Trade Literature

are discussed and illustrated in a booklet that also covers automatic machines, centrifugal dryers, heating and cooling coils, tank linings and rectifiers. The Udylite Corp. **(Circle 733)**

### Fasteners

Self-locking capscrews employ deflection of the locking collar to clinch both radially and axially. Klincher Kapscrew, Inc. **(Circle 734)** . . . Catalogs describe prestacked internal and external retaining rings. Industrial Retaining Ring Co. **(Circle 735)** . . . Condensed bulletin covers socket screw products, pressure plugs, lock nuts, spring pins, dowel pins and steel collars. Standard Pressed Steel Co. **(Circle 736)** . . . The various classes of spring-tension fasteners are summarized in a brochure that also shows customized designs and gives case histories. Associated Spring Corp. **(Circle 737)** . . . Reduced-dimension, lightweight types of self-locking fasteners for avionic and electronic use are presented in a catalog. Installation instructions for clinch nuts are given. Elastic Stop Nut Corp. of America. **(Circle 738)** . . . Eighteen-page design manual lists specific recommended installation torque values for thin and standard height UNC and UNF hex type elastic stop nuts. Elastic Stop Nut Corp. of America. **(Circle 739)**

### Finishing, Grinding

A revised edition of "Barrel Finishing" includes descriptions of the various barrel finishing processes, recommendations of the various abrasive shapes and sizes for applications in which they are best suited, case histories of actual uses, description of all types of finishing equipment available, discussion on compounds and their effects and a section on practical suggestions for operating procedures. Norton Co. **(Circle 740)** . . . Bulletin covers general-purpose grinding wheels. Recommended grain and grade specifications are included. Simonds Abrasive Co. **(Circle 741)** . . . Technical bulletin describes pressure-tested natural diamond grits. Diamond Tool Research Co. Inc. **(Circle 742)** . . . Thirty-two page catalog on high-frequency electric tools covers grinders, sanders, polishers, also impact wrenches, screwdrivers, nutsetters, drills, reamers and balancers. Thor Power Tool Co. **(Circle 743)** . . . A new profile grinder—a floor type tilting table machine that grinds or polishes contours and irregular shapes—is illustrated. Star Cutter Co. **(Circle 744)** . . . Use of a step tool relief-grinding fixture is presented. Harig Mfg. Corp. **(Circle 745)** . . . Standard coated abrasive products used throughout industry—abrasive belts, rolls, sheets and disks—are listed in a catalog. The Carborundum Co. **(Circle 746)** . . . "Wide Belt Finishing" recites case studies where use of wide belt machines has expedited production, lowered costs. The Carborundum Co. **(Circle 747)** . . . Bulletin about plain cylindrical grinding includes reference to the faster operating speeds coming into use under certain conditions. Simonds Abrasive Co. **(Circle 748)** . . . Brochure describes two types of waterproof coated abrasives. Armour Alliance Industries. **(Circle 749)** . . . A lubricating stick that contains molybdenum disulphide solid lubricant in a resin binder is particularly useful on grinding wheels and cutting tools. The Alpha-Molykote Corp. **(Circle 798)** . . . Complete line of semi-automatic machines for low production deburring, buffing and polishing operations is covered in a catalog. Acme Mfg. Co. **(Circle 799)** . . . Folder presents a


ANNOUNCING

The new **CRATEX**

TOOL & DIE MAKERS KIT

**The world's finest rubberized abrasives for deburring, smoothing and polishing** tools, dies, patterns, molds, models, instruments and component parts.

Kit contains 80 wheels and points in the most popular sizes and shapes, equally assorted in four grit textures, coarse (C), medium (M), fine (F), extra fine (XF)... plus four mandrels for ⅛" chuck... packaged in plastic box, compartmented for fast selection. $7.50 complete.

Order your new Cratex Tool & Die Makers Kit #777 through your distributor—or, send your order to us for delivery by the Cratex distributor nearest you.

*Free 8-page catalog available on request.*

**CRATEX MANUFACTURING CO., INC.**

1600 ROLLINS ROAD, BURLINGAME, CALIFORNIA

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pictorial story of the proper setup and turning of Turn-A-Tool diamond tools. The Staset Co., Inc. **(Circle 800)** . . . Thirty-two page booklet: "Tool Room Grinding" contains grinding and sharpening information for toolmakers and toolroom foremen. Specific wheel recommendations are given. Macklin Co. **(Circle 801)**

### Fluid Power

Specification sheet covers standard and magnetic line and sump strainers for hydraulic application. Ripley Screen & Strainer Co. **(Circle 802)** . . . Catalog on pipe thread and straight thread adapters for tubing system connections. Parker Fittings & Hose Div., Parker-Hannifin Corp. **(Circle 803)** . . . Twenty-page catalog gives facts and figures on automatic, safety lock and regular quick detachable couplers. Foster Mfg. Co., Inc. **(Circle 804)**

### Gearmaking

Technical data sheet gives complete specifications and describes operations of a new fully automatic crown-gear grinder. Gear Grinding Div., Michigan Tool Co. **(Circle 757)**

### Heat Treating

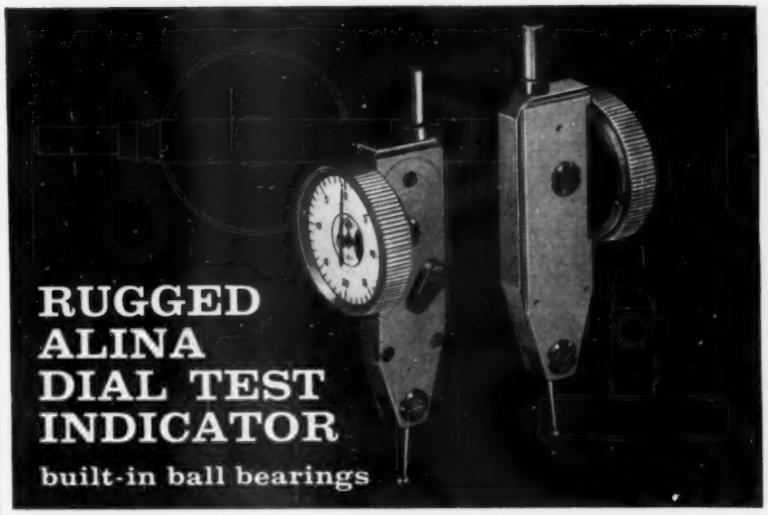
Hump mesh-belt furnace does continuous bright brazing, heat treating or sintering of stainless steel up to 2200 F. General Electric Co. **(Circle 758)** . . . Furnaces used for atmosphere tempering, annealing, and stress relieving are illustrated in a bulletin. Ipsen Industries, Inc. **(Circle 759)** . . . Shell molded conveyor belts for heat treating furnaces are described. Fahralloy Co. **(Circle 760)**

### Indexers

Speed indexers use pneumatic or hydraulic power to index rapidly, manually or automatically. Erickson Tool Co. **(Circle 761)** . . . Seven-inch diameter rotary indexing table provides whole-degree angular indexing with an accuracy of ¼ second of arc. Michigan Tool Co. **(Circle 762)**

### Inspection and Measurement

Expanded information on granite surface plate equipment and new information for tool designers on semisteel angle plates is included in a catalog. The Challenge Machinery Co. **(Circle 763)** . . . Methods of using stroboscopes and tachometers for analyzing rotating motion are included in a 12-page bro-

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ALINA
DIAL TEST
INDICATOR
built-in ball bearings

for greater sensitivity—reduced pressure—improved accuracy

- Jeweled • Shock Proof • Range .032" • Graduated .0001"
- Reading 0-20-0 • Fully reversible contact point
- *Holder attaches to stem or to integral dove tails on body*

Available with a wide variety of rectangular or round shanks.

*The instrument shown here is part of a complete line of precision DIAL TEST INDICATORS of all types — Write for brochure!*

ALINA CORPORATION
122 East Second St., Mineola, L. I., N. Y.
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McCROSKY
*Series "900"*
MILLING CUTTERS

**Face, End and Half Side Mills Fitted with Square or Triangular "Throw-Away" Carbide Inserts**

● Unsurpassed dependability and economy. Inserts are positioned accurately on ground surfaces in the body, locked rigidly and held solidly even under heavy work loads. Can be released easily and indexed quickly on the machine, assuring almost uninterrupted production. 24 standard sizes, 4" to 12" in dia. Also "Specials" to meet any requirement.

*Send for Bulletin No. 582 Today. It gives full details.*

McCROSKY TOOL CORPORATION
MEADVILLE, PA.
COST CUTTING TOOLS
*Engineering and Sales Representatives in the Principal Cities*
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chure. Power Instruments, Inc. **(Circle 764)** . . . Replacement parts and spares for dial indicator gages and setmasters are covered in a booklet that includes exploded drawings of each gage. Boice Gages, Inc. **(Circle 765)**

### Materials

Thirty-two page illustrated brochure describes content of new *Metals Handbook*, "Properties and Selection of Metals." American Society for Metals. **(Circle 766)** . . . Brochure covers inoculants for production of high-strength gray iron. Vanadium Corp. of America. **(Circle 767)** . . . Pocket-sized booklet discusses profitable utilization of high rigidity in a material that has three times the stiffness of hardened steel. Kennametal Inc. **(Circle 768)** . . . Chart gives mechanical and electrical properties of ceramics. American Lava Corp. **(Circle 769)** . . . Booklet, "Versatility in Rubber," details the broad abilities of rubber products to absorb sound and vibration, resist high voltage, solvents, oil and chemicals. Development and production of rubber parts is described. Roth Rubber Co. **(Circle 770)** . . . Engineering report gives details on a wear resistant aluminum hard coating. Allen Aircraft Products, Inc. **(Circle 771)** . . . Various kinds of corrosion and the different metals suited to resist them are reviewed in a 24-page illustrated brochure. The H. M. Harper Co. **(Circle 772)** . . . Condensed catalog contains basic application information and engineering data on laminated plastics and vulcanized fiber. Taylor Fiber Co. **(Circle 773)** . . . Data sheets cover three grades of steel—a deep air-hardening tool and die steel and two general-purpose tool steels for cold work applications. Heppenstall Co. **(Circle 774)** . . . Folder describes cast-to-shape products and contains material data sheets. Vanadium-Alloys Steel Co. **(Circle 775)** . . . Fifty-four page catalog lists U.S. Government specifications for a wide variety of adhesives, coatings and sealers. Adhesives, Coatings and Sealers Div., Minnesota Mining and Manufacturing Co. **(Circle 776)**

### Milling

Twenty-eight inch vertical Hydro-Tel milling machine is covered in a brochure. The Cincinnati Milling Machine Co. **(Circle 777)** . . . Operating data and specifications for a full line of constant-horsepower, infinitely variable speed standard milling spindles are published in a catalog. Colonial Broach & Machine Co. **(Circle 778)** . . . Complete line of indexable blade milling cutters is fully illustrated and dimensioned in a booklet. Futurmill, Inc. **(Circle 779)** . . . Horizontal boring and milling machine has many design improvements. S & S Machinery Co. **(Circle 780)** . . . Thirty-horsepower nine-speed milling spindle has a speed range of 50 to 1150 rpm. Futurmill, Inc. **(Circle 781)**

### Motors, Controls, Drives

Bulletin describes zero-error motor control that is used where regulated speed and exact positioning are required, as in numerically controlled machine tools. Sciaky Bros., Inc. **(Circle 782)** . . . Advanced design right-angle worm gear motors are illustrated in a brochure. U.S. Electrical Motors Inc. **(Circle 783)** . . . Manual starters for fractional horsepower motors are covered in a brochure. Furnas Electric Co. **(Circle 784)** . . . Controls for adjustable-speed operation of fractional horsepower d-c motors from a-c lines are discussed in a brochure. General Radio Co. **(Circle 785)** . . . Eighty-eight page publication covers a com-

plete line of variable speed motor drives, ¼ through 40 hp. Reliance Electric & Engineering Co. **(Circle 786)**

### Pressworking

Five models of hydraulic press brakes, from 200 to 500 ton capacity, are described in a bulletin. Die lengths are from 144 to 200.5 inches. National Automatic Tool Co. **(Circle 787)** . . . Ninety-deg and 30-deg air bend dies, flattening and offset dies, three and four way dies, and 90-deg gooseneck punches are covered in a bulletin illustrating standard press brake dies. Niagara Machine & Tool Works. **(Circle 788)** . . . Straight-side double crank presses are described in a brochure. Dechert Dynamics Corp. **(Circle 789)** . . . Quick-reference catalog illustrates hand and powered metalworking machines, plus single station punches and dies, adjustable punches and dies, standard Vee type press brake dies, roll form dies and snap form dies. Benders, brakes, punch presses, rod parters, rollers, notches, shears, spring winders and hole locator layout machines are covered. Di-Acro Corp. **(Circle 790)**

### Sawing and Shearing

Carbide-tipped saws for cutting woods, laminates and composition materials, plastics and nonferrous metals are covered in a catalog that shows different tooth styles and gives usage recommendations for each type of saw. Atkins Saw Div., Borg-Warner Corp. **(Circle 791)** . . . Shear blades—solid steel and laid steel—up to 180 inches long are the subject of a bulletin. Simonds Worden White **(Circle 792)**

### Turning

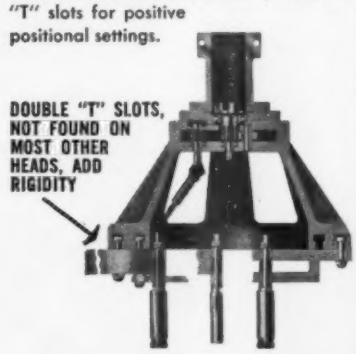
Comprehensive job portfolio illustrates metalcutting jobs run on W & S multispindle automatics. The Warner & Swasey Co. **(Circle 793)** . . . A new No. 2 automatic chucking machine is described in a bulletin that gives important features and full specifications. Brown & Sharpe Mfg. Co. **(Circle 794)** . . . New 13-inch, 15-inch, 17-inch and 19-inch Regal engine lathes are covered in a bulletin that also includes specifications and operating descriptions of Regal 17-inch and 19-inch plain and sliding bed gap lathes. R. K. LeBlond Machine Tool Co. **(Circle 795)** . . . Bulletin tells the story of the 21-inch and 24-inch Regal lathes. R. K. LeBlond Machine Tool Co. **(Circle 796)** . . . High-precision tracer lathes are illustrated in a folder. Cazeneuve Lathes, Inc. **(Circle 797)**

**JARVIS UNIVERSAL JOINT MULTIPLE SPINDLE HEADS**

* For example, you can add to the basic head one or more of 20 optional accessories (such as Spindle Assemblies, Spindle Cluster Plate, Base Plate, Guide Rods, etc.) to meet the requirements of a particular job. With Jarvis Heads you have a greater selection of parts and accessories. A buy-only-what-you-need, custom-built head without having to pay the high cost of regular custom designed heads. Universal joints are of an advanced structural design which feature: low deflection rate; superior fatigue resistance; greater overload capacity and longer life. Joints have a snap-on feature and can be slipped off the spindle without use of tools.

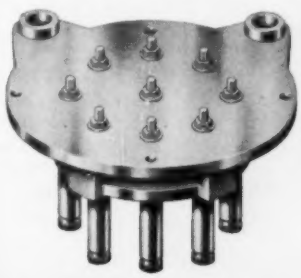
**EXCLUSIVE JARVIS FEATURES**

Cut-away view (below) reveals high strength, light weight aluminum alloy castings, heavily ribbed for durability; gears and spindle drivers run in ball bearings, have more than thrust load capacities; idler gears mounted on heavy duty needle bearings running on specially heat treated steel studs; adjustable outrigger arms locked in position with threaded studs located in double "T" slots for positive positional settings.




**NO NEED TO INVENTORY SEVERAL FIXED HEADS**

Head converts easily to a fixed head by adding a Jarvis Spindle Cluster Plate (shown below) which can be jig bored, by you or by us, to locate spindles to suit hole spacing required. Cluster Plates will aid in reducing setup time and will assure correct setup each time.



Jarvis CORPORATION

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30 Pease Ave., Middletown, Connecticut

____Send U.J. Multiple Spindle Head Catalog

Name _____ Title _____

Company _____

Street _____

City & State _____

SEE US AT ASTME SHOW BOOTH 1322
Use Reader Service Card, CIRCLE 169

# NEW MODEL 1220 DYNAPAK

## RUGGED POWERFUL EFFICIENT

**DYNAPAK MODEL 1220** . . . massive, rugged all-new model of industry's only proven *high energy rate forming* machine! All-new Dynapak saves expensive metal chips — eliminates costly machining.

**SAVES METAL**
**SAVES MACHINING**
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**May 8-9.** AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Lubrication symposium. Deauville Hotel, Miami Beach, Fla.

**May 8-10.** INSTRUMENT SOCIETY OF AMERICA. National power instrumentation symposium. LaSalle Hotel, Chicago, Ill.

**May 8-10.** National Aeronautical Electronic Conference. Sponsored by the INSTITUTE OF RADIO ENGINEERS and the INSTITUTE OF AEROSPACE SCIENCES. Miami and Biltmore Hotels, Dayton, Ohio.

**May 8-11.** AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the ENGINEERING INSTITUTE OF CANADA. Queen Elizabeth Hotel, Montreal, Que., Can.

**May 8-12.** AMERICAN FOUNDRYMEN'S SOCIETY. Castings congress and exposition. Brooks Hall and Civic Auditorium, San Francisco, Calif.

**May 9-11.** Western Joint Computer Conference. Ambassador Hotel, Los Angeles, Calif.

**May 9-12.** AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Production engineering conference. Royal York Hotel, Toronto, Ont., Can.

**May 11-13.** AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS. Conference and convention. Sheraton-Cadillac Hotel and Cobo Hall, Detroit, Mich.

**May 22-24.** National Telemetering Conference. Sheraton-Towers Hotel, Chicago, Ill.

**May 22-26.** AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Twenty-ninth annual engineering conference and exhibit. New York Coliseum and Statler Hotel, New York City.

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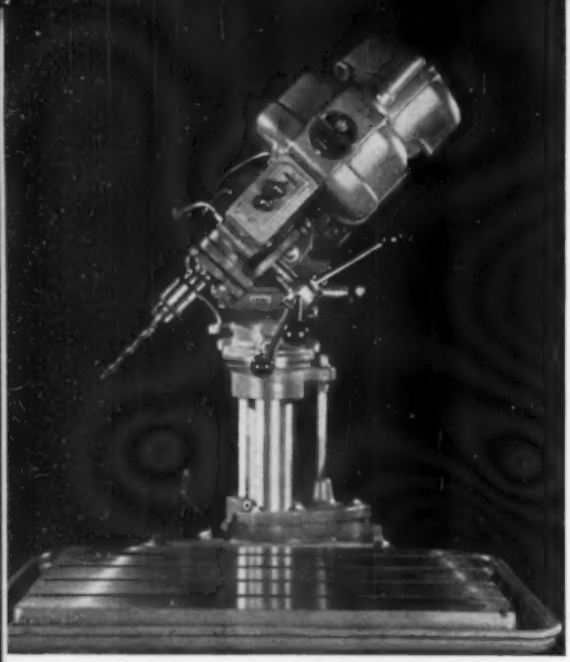

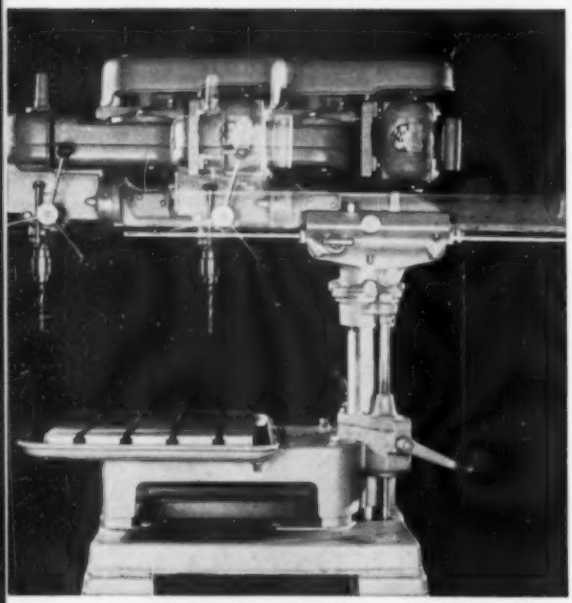

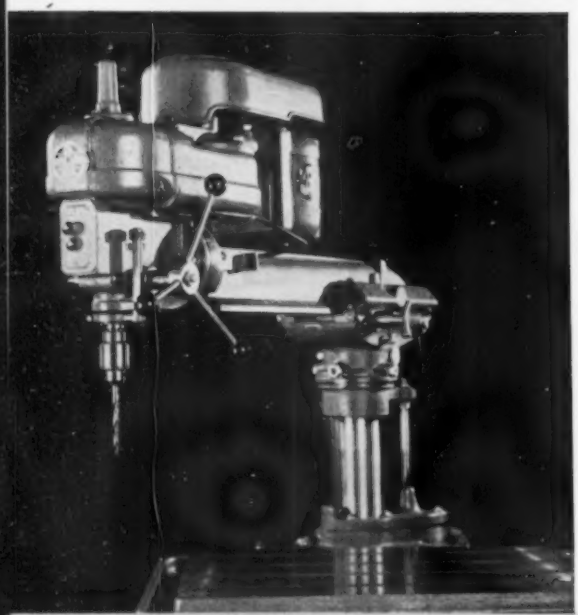

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# Tech Digests

## Methods Engineering in Material Handling

There are five ways in which methods engineering makes a contribution:

1. Standards application; 2. work simplification; 3. plant-engineering layout; 4. simulation of operations; 5. mathematical modeling.

All methods engineers are not concerned with all of these five things. The author has observed that methods engineers, either in consultative or in plant-engineering positions, employ one or more of these items; frequently they employ all of them at some time.

In an early stage, methods engineers rely greatly on work standards application or on plant-engineering layout. However dedicated to an understanding of motion study and standards, the industrial engineer quite normally utilizes the techniques of work simplification. In addition, more and more methods engineering is performed in the context of simulation of operations and on occasion mathematical modeling becomes necessary especially in rapid-fire plant expansion, forms of automatic warehousing.

In general, there are two types of study or investigation involved in studying or evolving a satisfactory materials-flow technique in a plant. These are, broadly speaking: 1. Enumerative studies; 2. analytical studies.

In an enumerative study, which is by far the most common type, the methods engineer encounters a continually growing list of places in the plant where bottlenecks exist or where complaints arise. This is to say that the engineer lists operating problems. Usually to investigate each of these is some form of enumerative study. The methods engineer collects data on production, available space, ideas of improvement, and reviews the facts with manufacturing management.

Many problems necessitate optimum of method and economics. The solution must be the only one that is closest to perfection. Many times the situation calls for not only a solution but a format for future expansion. Merely to solve the problem would be very costly if the method was not so flexible that adoption in future changes in plant layout would be practical. Hence, the necessity of balanced development, flexibility, optimizing the results. For this there is needed analytical study.

This term has found usage in operations research and in statistics. It relates to processes where there is an infinite number of items; it results in a parameter of evalution; it will, or is expected to, yield solutions that have highest probability of success in terms of statistical fact. The result of such a study to be good means finalizing, beyond all reasonable doubt or chance of error or probability of error in a given situation and within time and expense available, a correct solution. Thus, it can be seen why tools of work standardization, work simplification, plant engineering layout, simulation are frequently used.

A most difficult problem today, when it is encountered, is to provide adequate and flexible materials flow under conditions of unpredictable output-input quantities. Making the problem extremely complex are severe requirements in quality control, where error due to variance may prove of serious consequence at the point of use of the product. Equally interesting, if not so difficult, is the present and proposed plant where radical rethinking becomes urgently necessary on production, work standards, plant layout, or work simplification. Thus, in all these the significance of the role of the methods engineer is obvious and his work in determination of adequate flow techiques is very important. His function can be devoted to enumerative studies to evaluate and correct a specific item or thing. It can alternatively be an analytical study involving a process analysis and a complete essential flow technique.

Where the work relates to analytical study, plant layout or work simplification or simulation, and in some cases mathematical modeling may be used; at the present state of science, as it is developing, these are the available tools. Their practicability in each case depends on the complications and difficulties of each project. Their value also depends on the skill of the engineer and his thinking with regard to research techniques available in the current, rapidly changing world of science, space, and research.

From "Methods Engineering in Materials Handling," by J. C. Somers, Industrial Products Engineering Co., Long Island City, N. Y. Presented at the 1960 Winter Annual Meeting of the American Society of Mechanical Engineers, New York 18, N. Y.

## Standards for Data Processing

The need for standardization in the field of data processing technology has arisen primarily due to user pressure for compatibility of equipments. The establishment of basic units, symbols and definitions becomes mandatory for the advancement and exploitation of the field. In science at most a few individual workers are involved in the primary stages. In the data processing field many are involved—individuals, companies and other major economic units—in establishing standards for reliable and understandable communications between users and manufacturers, from human beings to machines. A most complex situation exists, in which the determination of standards is a delicate task whose solution must contribute to easing the present problems without increasing future problems.

Two basic communication problems exist. These are the communication between machines and the communication between humans and machines. The communications industry possesses an extensive technology with its own set of standards as determined primarily by the conditions required for successful communications between human

beings located at varying distances from one another. Historically, the major standardizing activities have been those involving the establishment of satisfactory levels of performance for the operation of telephone and telegraph systems connected by wire over routes of varying degrees of complexity. With the advent first of radio and then of television, the industry faced and mastered a new complex of standards problems. By the nature of its operations, however, the standards were of only academic interest to other industries who were users of the services rather than innovators.

With the advent of large scale computers and automatic data gathering equipment, the picture has changed drastically and dramatically. The economic utilization of large scale computers for business purposes requires that they be employed for the maximum amount of their available time. This in turn determines a hitherto unheard of rate at which information must be fed into one center for processing. The rate and means whereby applicable and required data must be gathered and converted into transmittable form is also defined by the type and class of equipment installed at the processing center.

The dollar sign hangs heavily. Dollars are involved in several ways. First, the computer-communications ensemble is dealing with the accurate allocation and payment of costs for the procurement and use of men, material, and time. If these are to be mechanized, the highest order of reliability must be achieved.

The initial step for constructive solution is the formulation of standards regarding the language, or methodology, of preparation of instructions for the computer. In brief, the language used in programming a computer must be so constructed and organized that a human operator can be employed without the necessity of a major new education in specific computer technology. Also, the computer must be able to arrive at accurate answers from data so presented. On the one hand, the best solution would be to talk to the computer in everyday language and have the computer not only accurately accept everything it was told, but also arrive at the logically impeccable conclusions. On the other hand, computers as presently designed are idiot geniuses. They follow instructions completely and literally at fantastic speeds. Their ability to determine logical inconsistency and to communicate backwards, requesting clarification is present in slight degrees. Indeed, the very concept of mechanizing data processing requires that backward communication for correction of instructions be held to a minimum. The solution for the computer is that of presenting it with detailed step-by-step instructions without omission and with complete logical consistency.

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Secondly, the terminal equipments provided by the data processing industry must be economic for the user. Establishment of appropriate standards is a basic requirement for specification of performance of such equipments in cooperation with communications systems.

Thirdly, the economic utilization of the communications systems requires a rapid rate of reliable data transmission. Here also a common set of standards is needed.

These three aspects indicate the complexity of the problem and the intricacies involved in arriving at a compatible solution. They also indicate the basic and fundamental need for the creation of appropriate standards.

The first solution is presently impossible, for such communication is not

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feasible between two human beings, and the structure of a computer is still of a far lower order than that of humans. The second solution is impractical because of the diversity of tasks presented to computers.

A second problem arises here, due to the differences between the use of computers for scientific and mathematical purposes and their use in business applications. First, the input-output problems are quite different in magnitude and orientation in the two fields of science and business. Second, the language of the business-man and that of the scientist are vastly different. Indeed, most of the time the two groups are almost totally unintelligible to one another. Rather than retrain both groups, which would most probably materially decrease their efficiency and effectiveness, a more practical solution is to provide the computers with two languages, one oriented towards the solution of scientific problems and the second similarly oriented for the solution of business problems.

The construction of such languages is a delicate and difficult task. A common denominator in defining the logical structure of computers must be found, and definitions of terms and operations must be made such that not only intelligible communications about the problem is possible but also that the creativity of the designers be preserved. A considerable major effort has been made, and is continuing, by the users and manufacturers of computers to arrive at compatible common language structures. To all it has become increasingly apparent that standardization of the most fundamental sort is mandatory if further progress is to be efficiently achieved.

From a paper "Communications and Languages in the Data Processing Field," by A. Craig Reynolds, Jr., Stromberg Div., General Time Corp., Thomaston, Conn., presented at the Eleventh National Conference on Standards sponsored by the American Standards Association, Inc., 10 E. 40th St., New York 16, N. Y.

## Bolt Loosening

An important requirement for the satisfactory performance of a bolted joint is the retention of a suitable clamping force. Decrease or loss of clamping force may result in such detrimental effects as slip, misalignment, slack, leakage, and reduced fatigue strength. Unfortunately, loosening can occur in a variety of ways, among which are rotation of the nut; crushing of surface irregularities; extrusion of dirt, paint, plating, or scale; creep; and plastic deformation.

This paper examines in detail several cases in which loosening is caused by plastic elongation of the bolt. Such plastic deformation occurs whenever the stress in the bolt exceeds the elastic limit. Obviously this can be prevented by keeping peak stresses below the elastic limit at all times. However, such a solution is not always practical or economical. For efficient use of bolts, clamping forces should be as high as possible, and it is common practice to tighten bolts initially to stresses near or even above the elastic limit. With an initial tightening stress near the elastic limit, peak stress due to imposition of an external load may easily cause this limit to be exceeded. Furthermore, it may be anticipated that requirements for bolted-joint applications of the future will be increasingly severe, necessitating minimum factors of safety while demanding maximum reliability. In view of this, a need is indicated for methods by which the amount of loosening may be predicted quantitatively, which in turn should permit rational determination of the best means of mitigating loosening in a particular application.

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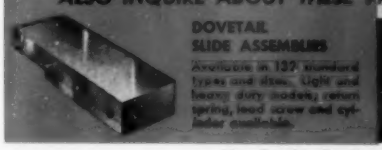

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## tech digests

amount of loosening which is admissible in a particular application. The toleration of some loosening by plastic deformation will permit the greatest external load for a given load. The amount of such loosening can then be minimized by specifying high tightening torques. Use of spring washers or, depending on conditions, addition or removal of gaskets may bring the loosening to within acceptable limits.

If, however, the application demands the complete absence of loosening, the initial tension must be kept below the calculated maximum value by a margin of safety. The maximum initial tension for no loosening increases as the external load is decreased, hence if high-clamping forces are desired the load must be small for a given size bolt or a larger bolt must be used for a given load.

From a paper "Loosening of Bolted Joints by Small Plastic Deformations" by O. A. Pringle, Associate Professor of Mechanical Engineering, University of Missouri, Columbia, Mo., presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

**TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT**

### Lubricating Rolling Contacts

The function that a fluid plays in thin-film lubrication of rolling-element bearings, gears, and cams has received very little attention when compared with the efforts expended in improving quality, materials and design. The only real guide to the choice of lubricant has been based upon a nominal viscosity for a given speed and operating temperature range.

From the simultaneous solution of the Reynold's, energy and elasticity equations for rolling cylinders, it was found that the elastohydrodynamic pressure distribution was almost identical to the Hertzian pressure distribution. This finding was further confirmed by photoelastic study on contacting cylinders which showed the stresses under dry and lubricated conditions to be virtually the same. However, the calculated temperature distribution was not the same when two lubricants with the same bulk viscosity but different temperature and pressure-viscosity coefficients were considered. The corresponding temperature gradients produce thermal stresses which must be considered in conjunction with the normal pressure distribution in order to determine maximum shear stress. Based upon these observations it is hypothesized that the lubri-

cant which produces lower thermal gradients within the contact zone will be the one which will yield the longer fatigue life in rolling contact. Using the method of analysis presented, it would appear to be possible to rank lubricants for specific operating conditions on a fatigue-life basis. The fatigue data on rolling elements confirms this premise. Therefore, a new criterion for rolling-element fatigue which depends on maximum local contact-zone temperature is proposed. Elastohydrodynamic analysis in which viscosity is a function of pressure, temperature, shear rate, and compressibility is possible for the purpose of qualitatively ranking lubricants. Since such an analysis yields lubricant temperature it may also be very useful for qualitative ranking of flash temperature or lubricant breakdown which influences scoring and scuffing.

It is recognized that other factors such as chemical stability, surface chemistry, corrosive action, nonhomogeneity of materials, surface finish, and so on, also have a major influence on fatigue life. In a number of cases these factors may be the governing ones. However, this investigation verifies the existence of an elastohydrodynamic film and establishes a very important function for the lubricant in rolling elements. It also provides an analytical method for ranking of lubricants.

1. Three distinct regions of lubrication are possible with rolling elements, hydrodynamic, elastohydrodynamic and boundary.
2. In the elastohydrodynamic region, the pressure distribution is very similar to that obtained by Hertzian theory. The magnitude of the maximum pressure analyzed by the elastohydrodynamic and the Hertzian theories are almost identical.
3. Under heavy load the deformation and pressure and temperature effects on viscosity must be included in analysis.
4. The lubricant which will produce lower maximum temperature is expected to give longer fatigue life.
5. Since cooling plays such a very important role, the oil inlet temperature should be as low as practical, and provisions should be made to keep the rolling element cool. A major function of the lubricant may be considered to be that of a coolant.
6. Fatigue life appears to be inversely proportional to viscosity index with petroleum lubricants.

From a paper "Theory of Lubrication and Failure of Rolling Contacts," by B. Sternlight, P. Lewis and P. Flynn, General Engineering Laboratory, General Electric Co., Schenectady, N. Y., presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

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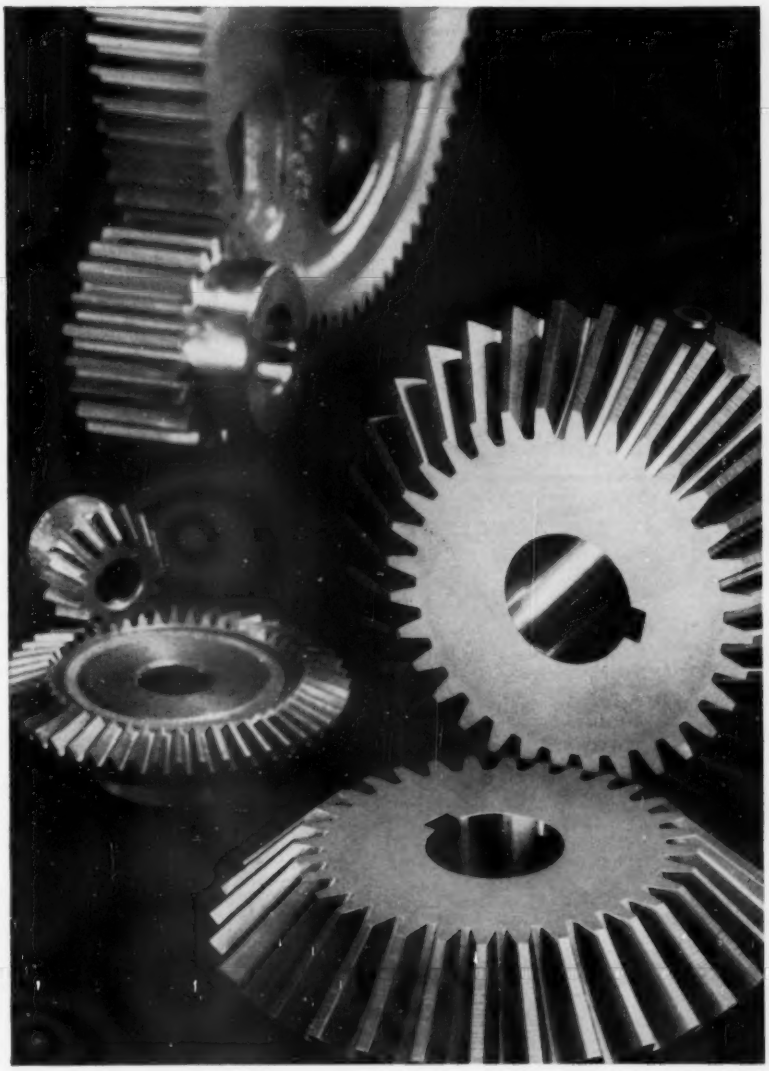

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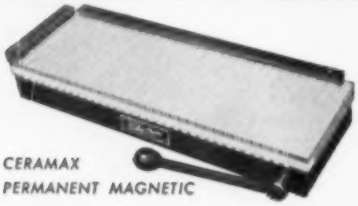

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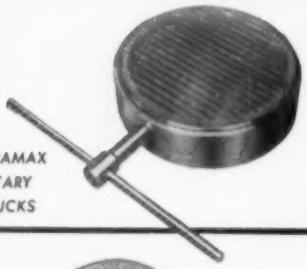

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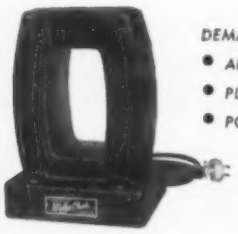

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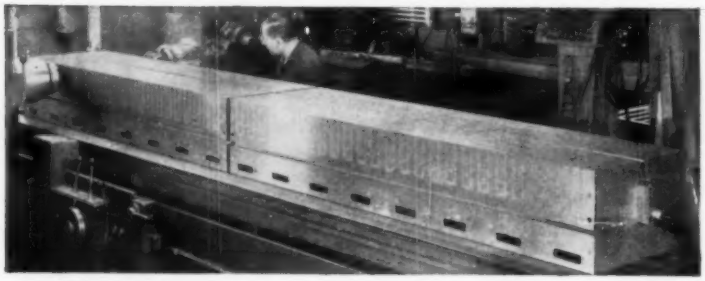

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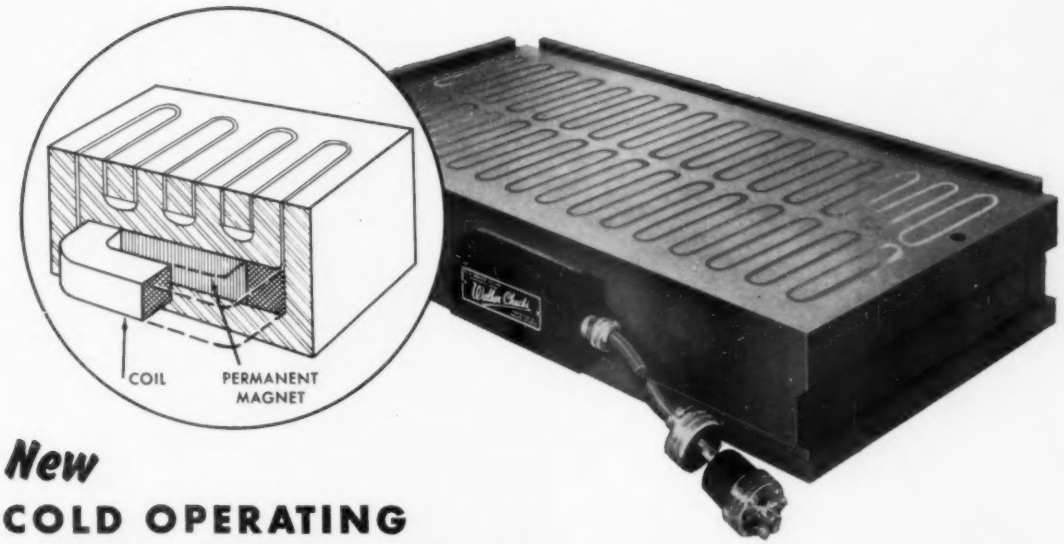


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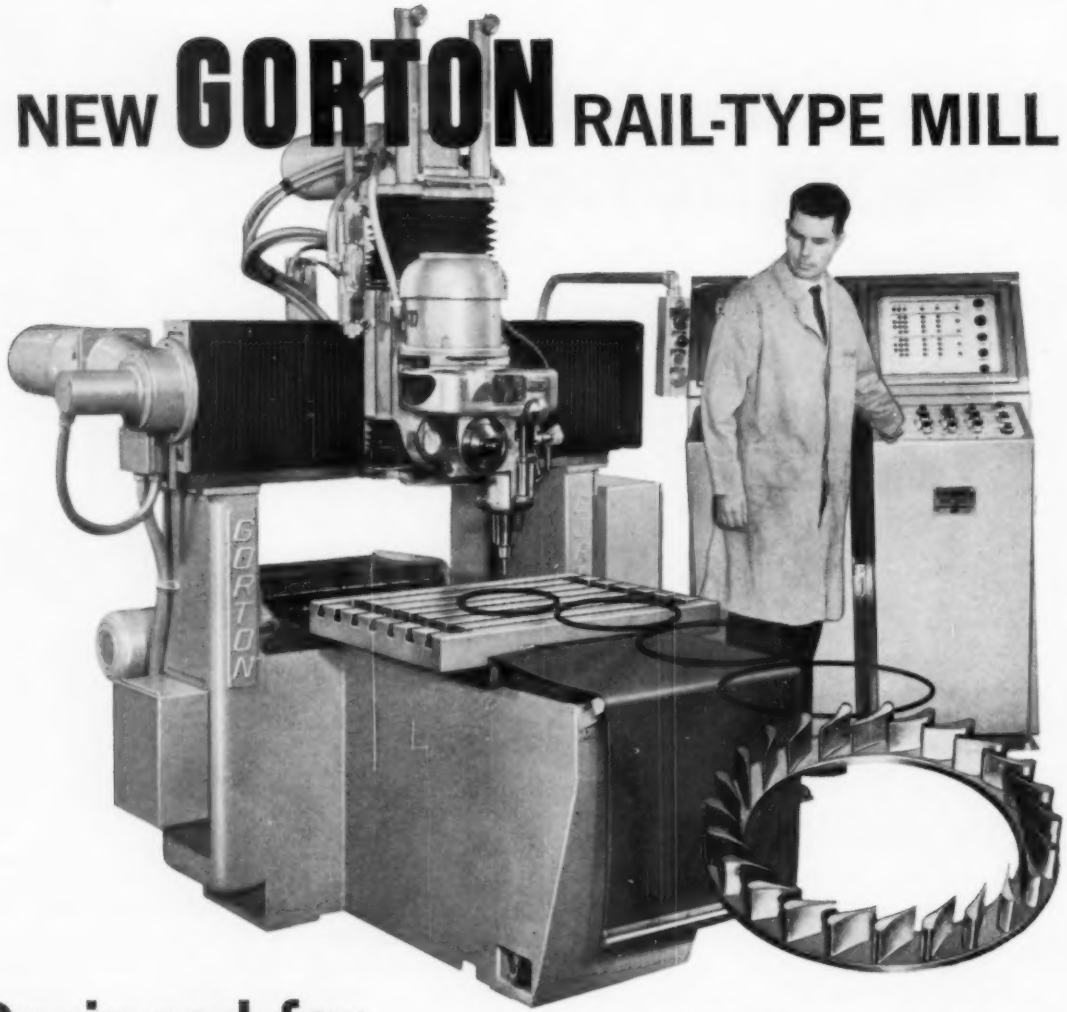
COMPANY, INC.
ROCKDALE ST., WORCESTER, MASS.

✱ '61

# NEW GORTON RAIL-TYPE MILL




## Designed for numerical control!

To satisfy the exacting requirements of numerical control, Gorton announces the all-new Double-Column Rail-Type Milling Machine. Designed for positioning and continuous path contouring system applications.

**Features**

- Precision ball bearing screws with preloaded nuts
- Positive anti-backlash drive system
- Bed-type design
- Electric or hydraulic motor control of axis movement
- All way surfaces guarded
- Unique air-balanced vertical slide
- Various types of heads available
- Spindle speed selection — manual or programmed
- Automatic lubrication

**Specifications**

| | |
|---|---|
| Table | 22" x 32" |
| Table Travel | (X Axis) 24" |
| Rail Slide Travel | (Y Axis) 32" |
| Vertical Slide Travel | (Z Axis) 10" |
| Quill Travel | (Manual) 4" |
| Spindle Speeds | 80-10,000 R.P.M. |
| Clearance between Columns | 36" |

See this machine in operation at the Thompson Ramo Wooldridge Booth, ASTME Show

*A Gorton Product, the Finest of its Kind!*

GORTON

SINCE 1893

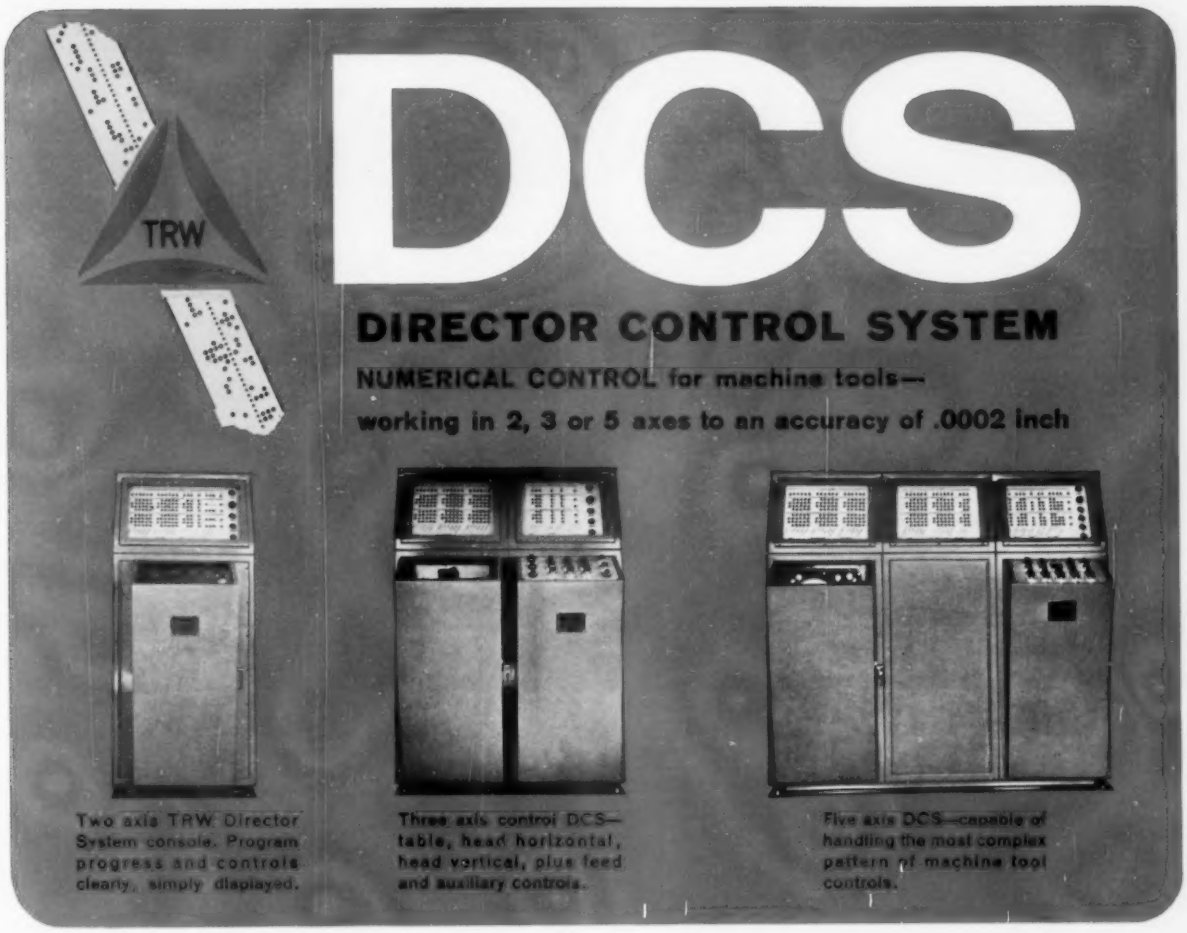
**GEORGE GORTON MACHINE CO.**

2605 RACINE STREET, RACINE, WISCONSIN

Milling, Die Sinking, Profiling and Engraving Machines with Manual Hydraulic, Electro-Hydraulic or Numerical Guidance Systems. Special Machines and Automated Transfer or Indexing Machines. Cutting Tools and accessories...Defense and special products.

# SEE IT IN ACTION AT THE ASTME SHOW

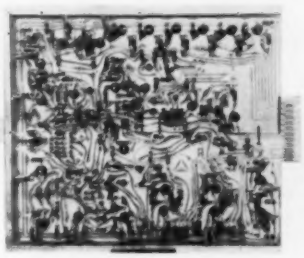
## directing the GORTON RAIL-TYPE MILL in 3 axis control


TRW
DCS
DIRECTOR CONTROL SYSTEM
NUMERICAL CONTROL for machine tools—
working in 2, 3 or 5 axes to an accuracy of .0002 inch
Two axis TRW Director System console. Program progress and controls clearly, simply displayed.
Three axis control DCS—table, head horizontal, head vertical, plus feed and auxiliary controls.
Five axis DCS—capable of handling the most complex pattern of machine tool controls.

Fast, accurate production can start quickly with a TRW Director Control System, because many parts to be made can have their programs punched into tape in your own shop in short order. While computers are useful on intricate jobs, a DCS can be programmed in your own shop—and we'll show you how.

This is the first solid state contour control system ever to be marketed for machine tools, and is completely proved in on-the-job performance. Simple, rugged, it will make one or a thousand parts exactly the same, even with complex curves, and auxiliary functions during the process. Mirror image, or right and left-hand parts at the touch of a switch.

Come and ask all the questions you like at booth 1536. Or, if you can't be at the show, phone or write us at Michigan City.



**Designed with "Outer Space" Precision**

Modular control boards created in their entirety by TRW—just as they are for outer space missiles, and to the same high precision, trouble-free service standards.

**Thompson Ramo Wooldridge Inc.**

Michigan City, Indiana



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# NEW TOOL STEEL SERVICE

simplifies purchasing (and saves money, too)

Buying assorted brands of tool steel creates costly paperwork for your . . .

purchasing and receiving departments — manufacturing and accounting, too.

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eliminate piles of paperwork throughout your plant . . .

carry fewer pounds in stock (reduce chances of inventory "mix-ups"), and . . .

**pay a lower price per pound** (by eliminating costs for small quantity "extras").

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CRUCIBLE STEEL OF CANADA, LTD., SOREL, QUEBEC, CANADA

# BATH Tap'n Gage TIMES

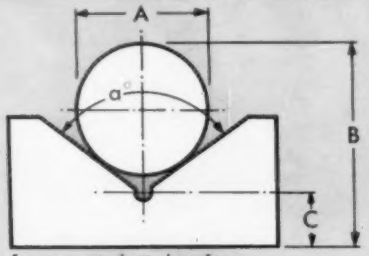
A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 13


# Subject: Thread Inspection of Taps with 3, 5 and 7 Flutes (Unified and American)

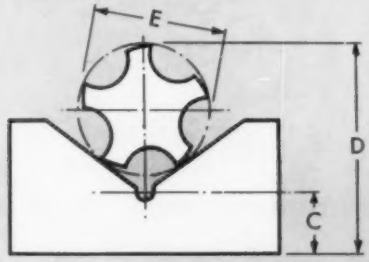
Pitch diameter and major diameter measurement of odd flute taps presents problems not found in checking even flute taps because the flutes are not opposite each other. This inspection plan provides a simple method of measurement so that the actual major and pitch diameters of taps having 3, 5 or 7 flutes may be determined. The so-called size of Vee Block (C) is found as shown by Figure 1. This size should be etched on the block for use in the formulas. The thickness of block is suggested as equal to at least 3 pitches, but not less than 5/16" thick for ease in handling. Complete equipment for this plan consists of precision Vee Blocks, measuring wires and micrometers.

Fig. 1



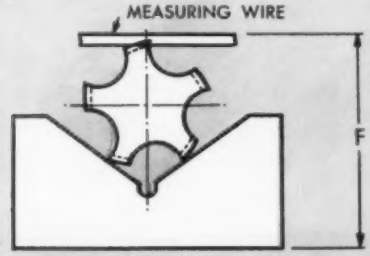

A = Dia. of any convenient size plug
B = Measurement of size plug mounted in Vee Block
C = Size of Vee Block

Fig. 2




D = Measurement of tap mounted in Vee Block with cutting edges in contact with sides of angle
E = Major Dia. of tap

Fig. 3




F = Measurement over Vee Block of tap with a wire inserted in the thread space at the cutting edge

## FORMULAS

### 3 FLUTE TAPS

a° = angle of Vee Block = 60°

1. $C = B - \frac{3A}{2}$ 2. $E = \frac{2(D - C)}{3}$

3. $D = \frac{3E}{2} + C$

4. Pitch Dia. of tap = 2(F − D) + E − *Constant for wire

5. $F = \frac{\text{Pitch Dia. of tap} + \text{*Constant for wire} - E}{2} + D$

### 5 FLUTE TAPS

a° = angle of Vee Block = 108°

1. $C = B - 1.118A$ 2. $E = \frac{D - C}{1.118}$

3. $D = 1.118\ E + C$

4. Pitch Dia. of tap = 2(F − D) + E − *Constant for wire

5. $F = \frac{\text{Pitch Dia. of tap} + \text{*Constant for wire} - E}{2} + D$

### 7 FLUTE TAPS

a° = angle of Vee Block = 128° − 34′ − 18″

1. $C = B - \frac{2.1099A}{2}$ 2. $E = \frac{2(D - C)}{2.1099}$

3. $D = \frac{2.1099E}{2} + C$

4. Pitch Dia. of tap = 2(F − D) + E − *Constant for wire

5. $F = \frac{\text{Pitch Dia. of tap} + \text{*Constant for wire} - E}{2} + D$

*The "best size" wire and constant may be found in Bath Catalog No. 55, Page 86, Columns 3 and 4. When "best size" wires are not available, use wires large enough to project above the crest of thread, and small enough not to ride on crest of thread.

Constant = (3x wire diameter)—(single height V-Thread)


• Cylindrical and Thread Gages • Ground Thread Taps • Internal Micrometers John BATH & Co., Inc.
28 Mann Street, Worcester, Mass.

# No hex screw or hex to the Cleveland

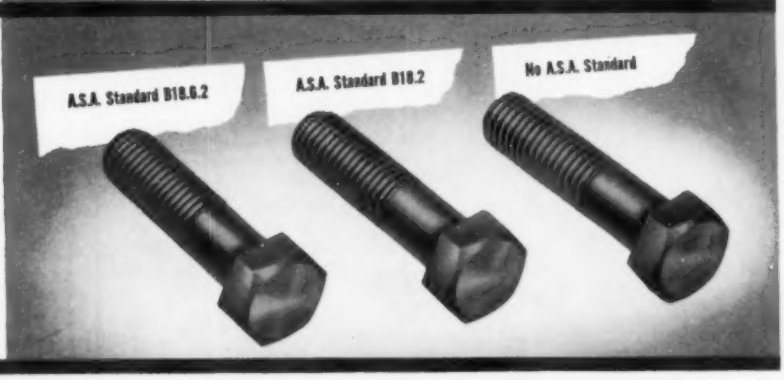
## Yet all three

**MEMO**

This ad presents important reasons for using Cleveland hex cap screws in your assembly designs and replacements. Cleveland quality costs no more. Insist on it.

The Cleveland Cap Screw Company

Buyers who specify this label eliminate the need for ordinary hex screws and bolts. Cleveland hex caps allow money-saving inventory reduction.




They look much the same and the prices are similar, yet only the Cleveland Hex Cap Screw meets the rigid ASA standard B18.6.2.

# bolt can measure up

# Hex Cap Screw

## cost the same!

**There are three compelling reasons for insisting on the Cleveland Hex Cap Screw:**

### 1. QUALITY

The Cleveland hex cap meets ASA standard B18.6.2—a very close tolerance standard. Only a loose tolerance standard covers hex bolts. There is no ASA standard for hex screws.

Specifically, the Cleveland hex cap offers these important features:

- Head and shank formed to the extremely close tolerances of ASA standard
- Concentricity of shank within ASA tolerance of 3% in order to assure that screw can be turned into a tapped hole
- A machined point for easy entry
- Washer faced bearing surface
- Sharp corners on head to insure positive wrenching action . . . and maximum safety
- Cold forged head for uniform grain flow in fillet and consequent reduction in stress concentration

### 2. INVENTORY

Why buy two when one will do? That's exactly what it comes down to. The Cleveland hex cap (with companion nut optional) provides a sure solution to both screw and bolt needs in a size range up to 1 x 8 in. A hex cap screw can be substituted for a hex screw or hex bolt, but a hex screw or hex bolt cannot be substituted for a hex cap screw. Since there is no need to stock ordinary hex screws and bolts, inventory costs can be sharply cut.

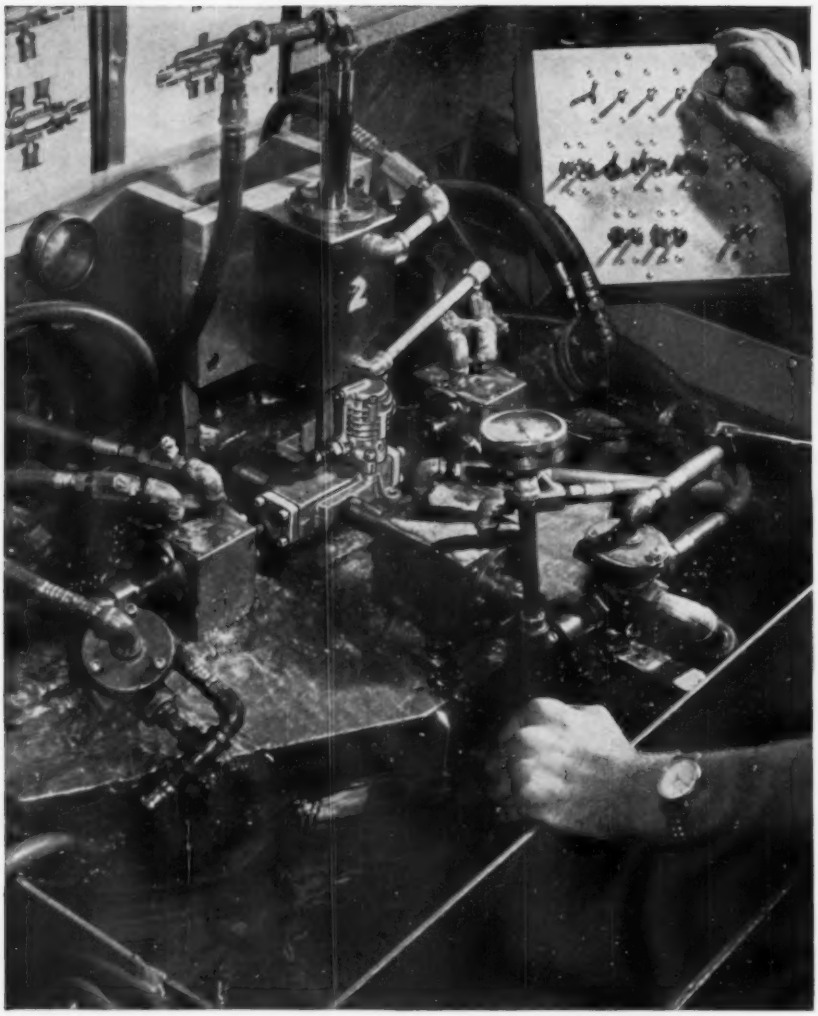
### 3. PRICE

The Cleveland hex cap, with its strict adherence to ASA standards and its universal application, is still no higher priced than non-standard hex screws and hex bolts. When quality costs no more, the choice is clear-cut.

**Contact your Cleveland distributor now. He stocks all standard sizes of hex cap screws in bright, quenched and tempered steels. Alloy steels are available on short notice.**

**THE CLEVELAND CAP SCREW COMPANY** 4420 Lee Road, Cleveland 28, Ohio

WAREHOUSES: Chicago • Philadelphia • Los Angeles • San Francisco • Atlanta



# test every valve?

Valvair does! How else can any manufacturer be sure that every valve he ships to a customer will function properly, from the first cycle on?

Each Valvair valve is cycled and re-cycled under water, at 30 to 50% above its rated pressure, to be certain that it meets Valvair's rigorous performance specifications. And, this final operating test is just one of the countless rigid quality control inspections each part of every valve must pass during its manufacture. In fact, one out of every twelve Valvair production men is a full-time inspector. Parts are scrutinized in process, as well as just prior to assembly. The most modern types of equipment, including optical comparators, surface finish indicators, optical and air gaging units, super magnifiers and precision gages, are used by the inspection team to assure Valvair's reputation for outstanding quality.

Specify Valvair components for the equipment you design, build or operate, to maintain your reputation for quality. For all the facts, write for Bulletin 59-SK, or call your nearby Bellows-Valvair Field Office. Address Bellows-Valvair, Akron 9, Ohio, Dept. TE-561.

**Bellows-Valvair**

*AKRON 9, OHIO*

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8171

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### with ASA Symbols and ASA Conversion Tables

Here is a complete listing of all A S A unified drill bushing symbols. It's a unique, comprehensive identification system for all standard sizes, designed to prevent errors and provide uniformity in specification, ordering and handling drill bushings. If you have been confused with the multitude of symbols and sizes, your troubles are over. For your benefit ACE has brought the new terminology together in one handy catalog, including a comparison of the markings of all leading makes with the new A S A symbols.

This is the first ALL NEW 1961 DRILL BUSHING CATALOG that is complete in every detail. You'll find many pages of separate listings for ground and unground standard, micro and supersizes, Thin Walls and Bushings for Embedment. Over 25,000 listed sizes, 6000 comparative symbols, technical data on all types, list prices and quantity discounts. For your *free copy*, just mail us a card; print name and address plainly, and say — "1961 Ace Catalogs." You'll receive them promptly.

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Have you checked your operation recently? One of the easiest ways to do so is to call in a highly trained MOCO oven system engineer. He can point out many improvements in your operation and recommend the very best equipment to modernize your processing. Why not check with him today for more heat processing efficiency tomorrow!

**YOU'LL WANT THESE BASIC OVEN FACTS IF YOU DO ANY OF THESE OPERATIONS . . .**

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This Fact Book by MOCO engineers on the basic operating principles of heat processing ovens should prove interesting. If you have specific questions, please write.

**MICHIGAN OVEN COMPANY**

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*to most machine tools*

- *Opens a whole new dimension in precision production!*
- *Operator sees the work magnified while in process!*
- *Improves quality, increases productivity, simplifies operator training!*

**A versatile attachment for improving efficiency of these machine tools:**

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*. . . or almost any lathe, grinder, miller or shaper*

See piece magnified while working it . . . not afterward when it may be too late. Measure and check it against overlay charts. Projector improves quality and tremendously simplifies close tolerance work. Cuts down errors and costly scrap. Allows you to do work you might not otherwise be able to handle.

Model 7M. Standard magnifications from 10X to 100X.

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## IMMEDIATE DELIVERY ON SOFT BLANK TOP JAWS

### BIG SAVINGS

Soft-Blank Top Jaws are made to American Standards and may be used on any chuck having master jaws that are made to these specifications.

Both Medium and Heavy Duty styles are carried in stock and are available for immediate delivery from 1020 steel.

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**HURON MACHINE PRODUCTS INC**

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# VALUE ANALYSIS FACT SHEET

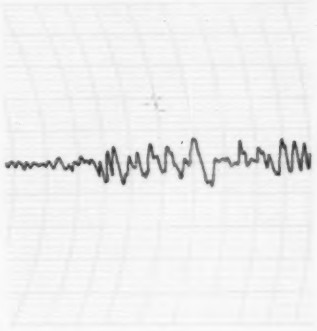
## Formbrite Drawn Brass Parts

**How to open finishing room bottlenecks and cut polishing costs up to 50%—produce stronger, more scratch-resistant parts—and get additional savings —with Formbrite, superfine-grain drawing brass.**

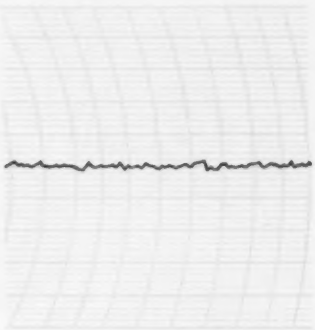
Very often in the production of drawn brass parts which are to be plated or lacquered, finishing costs are greater than those of all preceding operations —or even the cost of the metal. Under any circumstances, they are a high percentage of total costs.

Furthermore, parts go through the pressroom a lot faster than they can through the finishing room, creating bottlenecks in production.

**ENLARGED SURFACE TRACES** at the right prove that you can lick both cost and time problems with Formbrite®, Anaconda superfine-grain drawing brass. Savings in polishing costs reported by users run from 40 to 50%. These are net savings, as Formbrite costs no more than ordinary drawing brass.

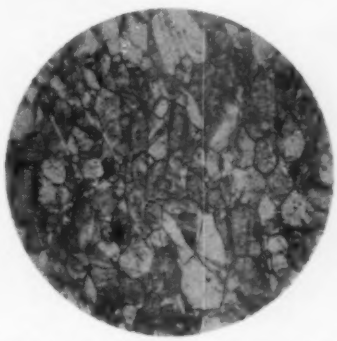


Enlarged surface trace of standard drawing brass (grain size, .045 mm) after 40% elongation. This kind of roughness causes "orange peel" effect in the working of standard drawing brass. Smoothing such mountains down to the valleys takes considerable cutting.

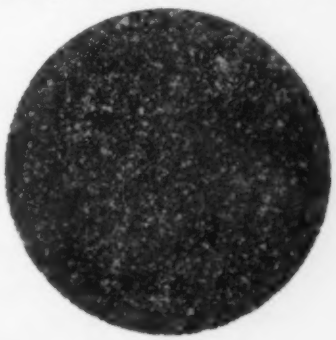


Enlarged surface trace of Formbrite drawing brass (grain size, .005 mm) after 40% elongation. Surface smoothness after deformation is the test of a drawing brass's polishing characteristics. It is relatively easy to level these little hills on the surface of Formbrite. In many cases, users find they eliminate cutting operations altogether, need only a simple color buff.

**STRONGER, MORE SCRATCH RESISTANT.** Formbrite is stronger, harder, springier than the usual drawing brasses in the same standard tempers, yet retains remarkable ductility for forming and drawing, and takes sharp, clean-cut ornamental die impressions. The harder surface means fewer rejects from scratching and marring during handling. In some instances, the superior strength and hardness of Formbrite make possible the use of a thinner gage metal, with an additional saving in material cost.



This is the microstructure, shown 75x, of the standard drawing brass used above.



This uniform superfine-grain structure of Formbrite, shown 75x, is produced by special procedures for rolling or drawing and annealing developed by Anaconda American Brass Company.

**SIZES AND TEMPERS.** Brass manufactured by the Formbrite method, with its special characteristic of superfine-grain structure, is supplied in standard Formbrite temper, half-hard, three-quarter-hard, hard, and extra-hard tempers, and can be rolled in heavy coils to .004″ in thickness by 24″ wide, weighing 100 pounds per inch of width. The table below gives physical data and terminology for Formbrite tempers.

**ALLOYS.** In addition to 70-30 brass, the following Anaconda alloys also are produced by the Formbrite method: Yellow Brass-59, Gilding Brass-4, Commercial Bronze-14, Red Brass-24, and Low Brass-32.

**TECHNICAL ASSISTANCE.** For help in selecting the alloy and temper to handle your particular job—for a copy of Publication B-39 with more details about Formbrite—see your Anaconda representative. Or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6145

**TERMINOLOGY FOR FORMBRITE TEMPERS**

| TENSILE STRENGTH LB. SQ. IN. | | ROCKWELL B HARDNESS | | DESIGNATION TO BE USED |
|---|---|---|---|---|
| MIN. | MAX. | MIN. | MAX. | |
| 49,000 | 59,000 | 40 | 65 | Yellow Brass—Formbrite |
| 57,000 | 67,000 | 60 | 77 | Half-hard Yellow Brass—Formbrite |
| 64,000 | 74,000 | 72 | 82 | Three-quarter-hard Yellow Brass—Formbrite |
| 71,000 | 81,000 | 79 | 86 | Hard Yellow Brass—Formbrite |
| 83,000 | 92,000 | 85 | 91 | Extra-hard Yellow Brass—Formbrite |

**FORMBRITE**

**Superfine-grain drawing brass**

**a product of**

**ANACONDA®**

*Anaconda American Brass Company*

# Why let long-established habit dictate your selection of grinding wheels?

Sure, the grinding wheels you've always used may be doing the job, *BUT . . . is that job good enough* in today's cost squeeze? Let Simonds help *you* update *your* grinding practices. Complete line, available through Simonds distributors, includes wheels of all abrasives and bonds, all sizes and shapes . . . all industrially-renowned products, in efficiency-proved specifications . . . and backed by our 60 year reputation as a top-rank producer of abrasive grain and grinding wheels. Send for complete descriptive catalog.

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*CALL YOUR SIMONDS DISTRIBUTOR*
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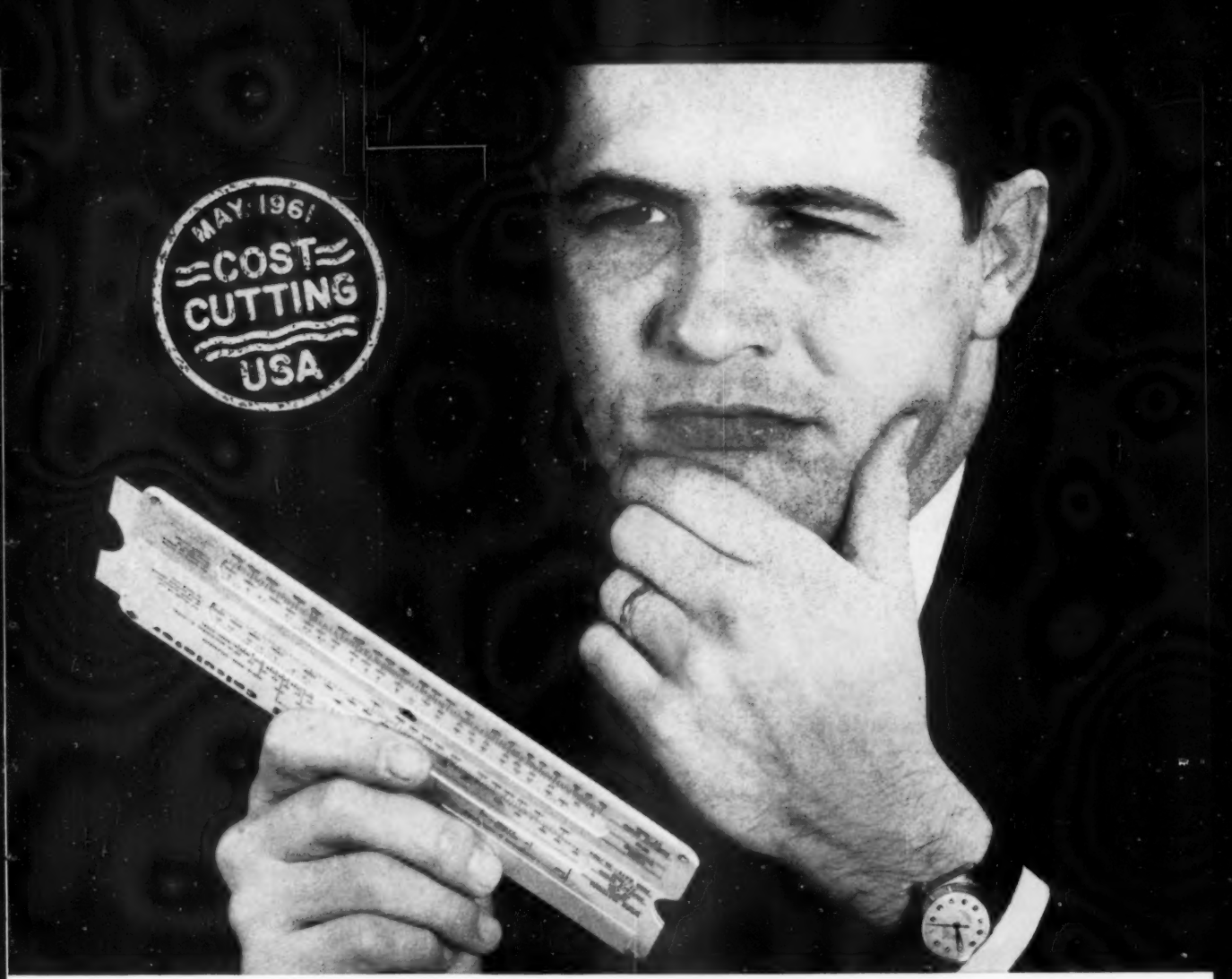


# SOMETHING WRONG: (*same cutting speed . . . different costs!*)

**Yes, if feeds and speeds are set by machinability to get long tool life, something is drastically wrong. Because it just doesn't make sense to operate a $1.50 drill in a $3,000,000 transfer machine at the same speed as in a $4000 upright. Not if you want least cost per piece. Simply stated: cutting speed should be that which gives you lowest combination of: (1) machine-hour charges and (2) tool replacement cost. Now, let's look at savings. Scully-Jones Quick-Change tooling reduces the highest increment of tool replacement cost—downtime for changing and resetting tools. The lower your tool cost, the faster you can run your machines. So both elements of total cost go down. We have designed Quick-Change, preset tooling for almost every kind of machine tool, and can design others for your special needs. The cost? You cannot find it in the price of a piecepart. Increased machine running time, alone, more than pays for the tooling. Call your S-J representative for application ideas and estimates.**

***Scully-Jones and Company***

*1915 South Rockwell Street, Chicago 8, Illinois*

SCULLY JONES

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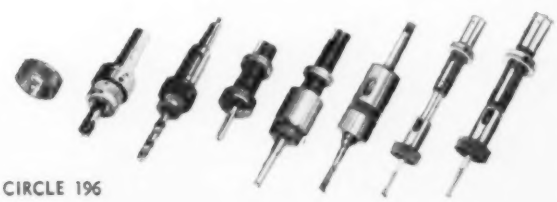
**QUICK-SET TOOLING**



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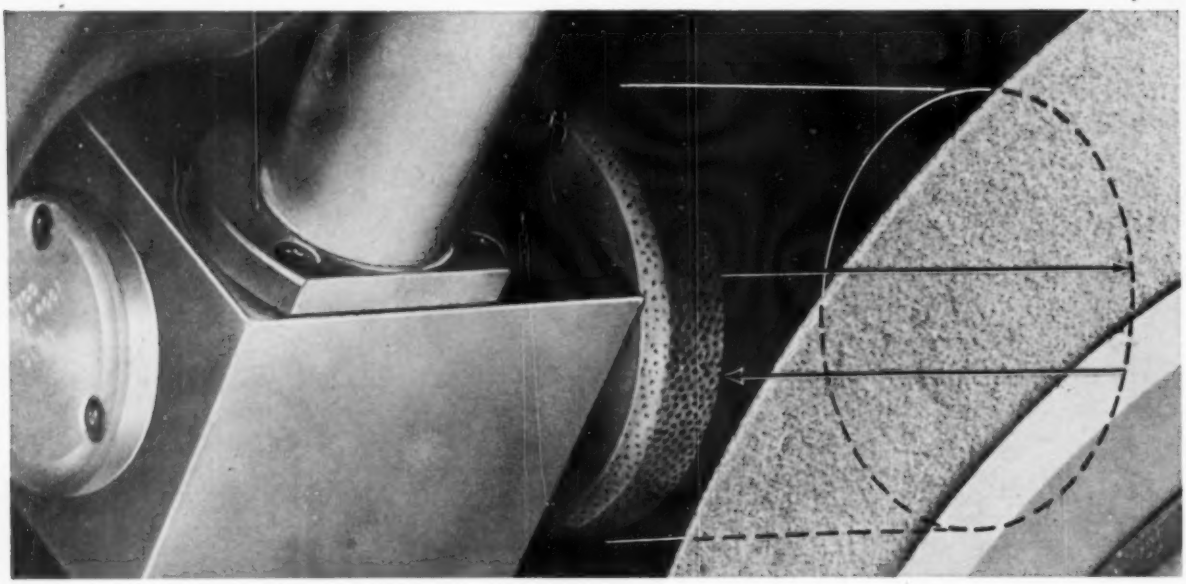


# NEW TRU-GRIT® ROTARY DIAMOND DRESSING TRAVERSE WHEEL controls finish, ends tool-change downtime loss, develops taper-free grinding face, holds accuracy, cuts production costs.

The new Tru-Grit Rotary Traverse Dressing Wheel is a straight-faced, power-driven wheel with hundreds of high-quality, small, selected diamonds hand-set in an overlapping cutting pattern.

Ideal for use on straight-faced grinding wheels, it presents to the grinding face, not one single diamond point, but hundreds of small, sharp, fast-cutting diamond points which generate uniform fracture of the grinding face and consequent uniformity of finish on the workpiece, impractical by other methods.

This dress, performed in a single, swift pass at regular intervals with minimum infeed, imposes negligible wear on dressing wheel and grinding wheel, yet keeps the grinding face uniformly sharp and free-cutting.

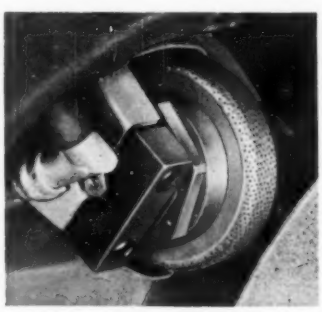
Thus, since there is virtually no change in the cutting face of the wheel from one grind to the next, workpiece finish is maintained at controlled uniformity.

Grinding face need never become loaded or dulled to the point where finish falls below specification. Specified finish can be maintained with minimum operator attention. Where desirable, the entire application can be automated.

Available finishes are within the 30-55 rms range. Taper-free straight surface is developed within .0002″ and geometrical roundness of workpiece diameter within .0002″.

There is no recurrent downtime for tool set-up. A typical Tru-Grit Rotary, Power Driven Traverse Wheel set-up on a grinder using a 24″ x $3\frac{5}{16}$″, 60-grain wheel, developing an oil-retaining finish within 30-55 rms, remained in original setting until replaced with a new one after it had performed 10,930 dressings and the wheel had produced 1,366,512 pieces. Obviously, savings were substantial.

The Tru-Grit Diamond Dressing Traverse Wheel may hold equally important cost-cutting potential for you. We invite you to write us about possible applications.



Finer finishes in the 12-18 rms range are available by using the Tru-Grit Contact-driven Rotary Wheel which is powered by contact with the grinding wheel.

## WHEEL TRUEING TOOL COMPANY

*Established 1910*

Main plant and laboratories: **213-3200 W. DAVISON AVE., DETROIT 38, MICHIGAN**

Plants in Dallas and Los Angeles • Representatives in major cities throughout the world

**WHEEL TRUEING TOOL COMPANY OF NEW JERSEY**
33 West Street, Bloomfield, New Jersey

**WHEEL TRUEING TOOL COMPANY OF CANADA, LTD.**
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**INDUSTRIAL DIAMONDS**—largest stock in the Americas • **DIAMOND TOOLS**—Engineered to the job and guaranteed to do it.
**DIAMOND DRILLS** for Mining and Oil Field use • **DIAMOND DRILLS, SAWS** and **PORTABLE MACHINES** for Masonry Drilling

# ADJUSTABLE

# MAGNIFICATION

## *REDUCES AIR GAGE COSTS*

## PICK YOUR DIAL

- 27 STOCK DIALS ON TWO STANDARD MODEL AIR GAGES COVER MAGNIFICATION FROM 35X TO 4,000X OR 2,000X TO 28,000X.
- THE GAGE FITS THE JOB. NO COMPROMISE.
- CLIP ON DIALS AND EASY ADJUSTMENT ENABLE GAGING SET-UPS TO BE CHANGED IN MINUTES.
- EACH AIR PLUG OR AIR RING COVERS A LARGE RANGE OF TOLERANCES AND ZERO POINTS; MANY EXISTING PLUGS AND RINGS CAN BE USED.
- ASK YOUR MAN-FROM-STANDARD FOR AN ON THE JOB DEMONSTRATION.
- WRITE TODAY FOR OUR NEW AIR GAGE CATALOG #61 AND SPECIAL REPORT "REDUCE AIR-PLUG COSTS — HOW TO DO IT."

## STANDARD GAGE COMPANY, INC.

POUGHKEEPSIE, N. Y. TELEPHONE GROVER 1-3100

LOOK WHAT YOU CAN DO NOW...ONLY with the

# PULLMAX

The Machine That Does More Operations Than Any Machine Of Its Kind

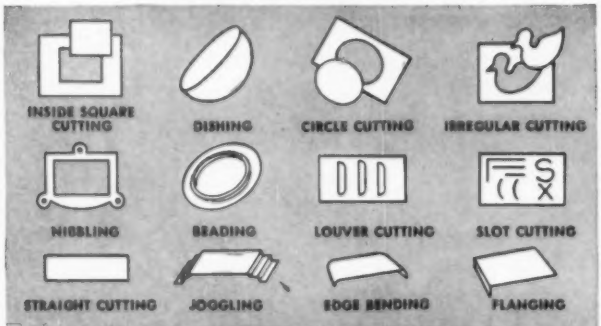
**6**

**STANDARD LOCK FORMING OPERATIONS FOR SHEET METAL**

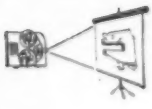
ASTME Show
New York City
May 22-26
Booth #2012

Now Pullmax offers more versatility than ever before (more than any machine of its kind) with 6 new lock forming tools to perform standard operations on sheet metal up to 16 ga. With these plus the 12 standard operations shown below, Pullmax is truly a "Complete metal shop in one machine".

**ALL IN ADDITION TO THE 12 OPERATIONS ALREADY AVAILABLE**




**THERE IS NO SUBSTITUTE FOR PULLMAX**
**THE ORIGINAL SHEARING AND FORMING MACHINE**



16M.M. Sound movie available for you to see Pullmax in action.

We'll send a demonstration truck right to your plant, tell us when

*WRITE FOR CATALOG Of MONEY SAVING METAL WORKING IDEAS*

BACKED by "Factory-To-You" DIRECT SERVICE

## AMERICAN PULLMAX CO., INC.

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PULLMAX (CANADA) LIMITED
S. Service Rd., Oakville, Ontario, Canada, P. O. Box 460

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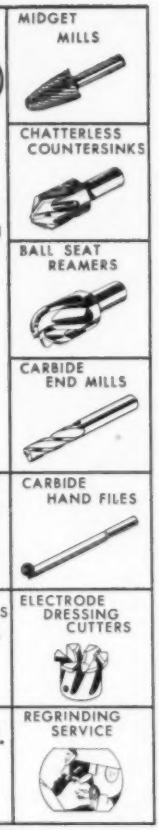
**YOUR SPECIAL CUTTING TOOL PROBLEMS ARE SOLICITED.**

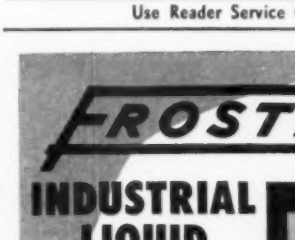
You are welcome to our 25 years experience in designing and producing Special Cutting Tools.

*Submit your problem— with sample part, if feasible OR we'll manufacture to your specifications.*

Thousands of *Severance* SPECIAL CUTTERS shipped monthly!

*ASK FOR A QUOTATION TODAY!*




*Severance* TOOL INDUSTRIES INC.
728 Iowa Avenue
SAGINAW, MICHIGAN

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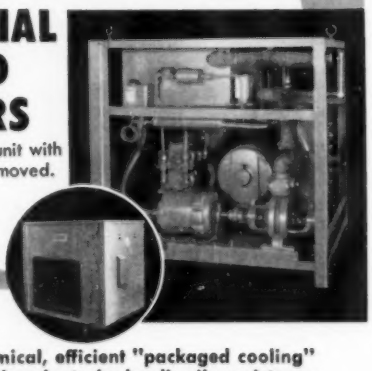
# FROSTRODE

## INDUSTRIAL LIQUID COOLERS



Frostrode unit with cabinet removed.

**. . . for economical, efficient "packaged cooling" of machine tool coolants, hydraulic oils, resistance welders, temperature control systems, and space cooling systems.**

**These compact units have demonstrated their versatility and superiority through years of reliable, on the job service in the nation's top manufacturing plants.**

**A Frostrode engineer will gladly help in the solution of your cooling problems.**

★ *See us at Booth #3825, ASTME Show, May, 22-26.*

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Schrader means quality . . . in complete lines of double-acting and single-acting cylinders in a variety of sizes . . . including JIC and miniature cylinders. Schrader Air Cylinders . . . as well as complete lines of Valves and Accessories . . . are at work on many OEM products and in thousands of plants performing countless jobs. Your Schrader Distributor is fully stocked . . . staffed with experts to help you solve any air circuitry problem.

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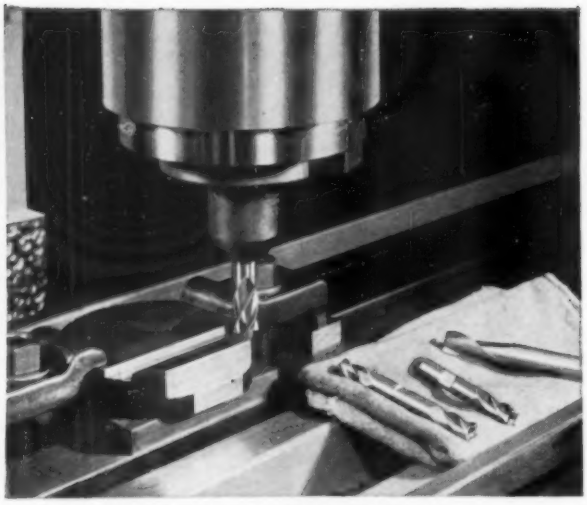
QUALITY AIR CONTROL PRODUCTS



**HERE ARE THE ACTUAL TEST FACTS...**
TOOL USED: 4 flute Thriftmill, ½"
MACHINE: Brown & Sharpe Milling Machine

## *Brown & Sharpe*

# Thriftmills®

## Proved first in Economy and first in General Purpose Performance on TOOL STEEL, IRON, BRASS, ALUMINUM, PLASTICS and FIBER!

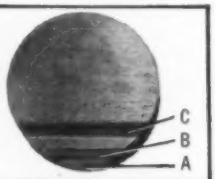
**RECORD PERFORMANCE**
Shop tests show conclusively that the B&S Thriftmill is a revolutionary new tool that can cut efficiently any conventional material and many new, hard-to-mill alloys and synthetics.

**RECORD SAVINGS**
Despite a price tag 20% lower than conventional end mills, the B&S Thriftmill, because of its extreme versatility, makes many high priced general purpose end mills obsolete.

**STEEL**

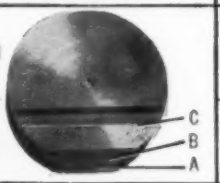
**NICKEL CHROMIUM MOLY**
**A1S1 8620** — **130 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | VERY GOOD |
| C | 2 13/16" min. | 530 RPM | GOOD |



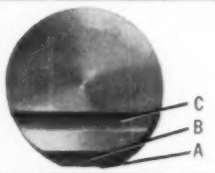

**NICKEL CHROMIUM MOLY**
**A1S1 E 8650** — **165 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 7/8" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | VERY GOOD |
| C | 2 13/16" min. | 530 RPM | VERY GOOD |



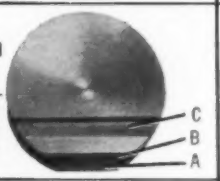

**STRAIGHT CARBON TOOL STEEL**
**A1S1 Type W-1** — **165 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | EXCELLENT |
| C | 2 13/16" min. | 530 RPM | EXCELLENT |



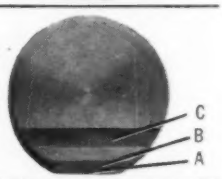

**LOW ALLOY TOOL STEEL**
**A1S1 Type L-6** — **180 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | EXCELLENT |
| C | 2 13/16" min. | 530 RPM | EXCELLENT |



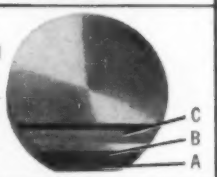

**SHOCK-RESISTING TOOL STEEL**
**A1S1 Type S-1** — **245 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | GOOD |
| B | 3¼" min. | 530 RPM | GOOD |
| C | 2 13/16" min. | 530 RPM | GOOD |



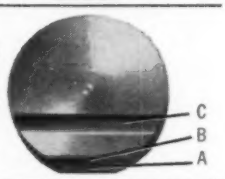

**HOT WORK TOOL STEEL TUNGSTEN BASE**
**A1S1 Type H-13** — **190 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | GOOD |
| B | 3¼" min. | 530 RPM | GOOD |
| C | 2 13/16" min. | 530 RPM | EXCELLENT |



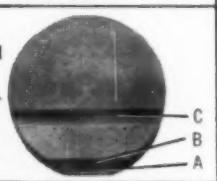

**COLD WORK TOOL STEEL**
**A1S1 Type O-1** — **190 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 670 RPM | GOOD |
| B | 3¼" min. | 670 RPM | GOOD |
| C | 2 13/16" min. | 670 RPM | EXCELLENT |



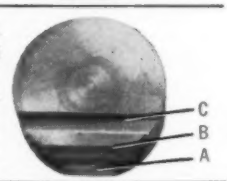

**MEDIUM CARBON STEEL**
**A1S1 1035** — **170 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 7/8" min. | 670 RPM | EXCELLENT |
| B | 3¼" min. | 670 RPM | VERY GOOD |
| C | 2 13/16" min. | 670 RPM | VERY GOOD |




**LEADED MEDIUM HARDENABILITY CASE STEEL**
**A1S1 4150** — **194 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 7/8" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | VERY GOOD |
| C | 2 13/16" min. | 530 RPM | VERY GOOD |




**MEDIUM ALLOY AIR-HARDENING TYPE**
**A1S1 Type A-2** — **220 Brinell**

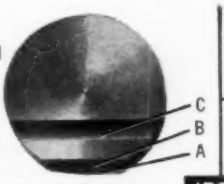
| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | EXCELLENT |
| B | 3¼" min. | 530 RPM | GOOD |
| C | 2 13/16" min. | 530 RPM | GOOD |

**MEDIUM ALLOY AIR-HARDENING TYPE**
**A1S1 Type A-2** — **286 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | FAIR |
| B | 3¼" min. | 530 RPM | GOOD |
| C | 2 13/16" min. | 530 RPM | EXCELLENT |

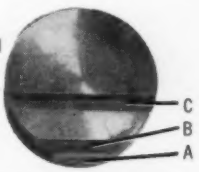
**CHROMIUM BEARING STEEL**
**A1S1 52100** — **170 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 4½" min. | 530 RPM | EXCELLENT |
| B | 3¾" min. | 530 RPM | EXCELLENT |
| C | 2 13/16" min. | 530 RPM | EXCELLENT |




**FREE CUTTING CARBON STEEL**
**A1S1 C1141** — **194 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 7⅛" min. | 670 RPM | EXCELLENT |
| B | 3¾" min. | 670 RPM | VERY GOOD |
| C | 2 13/16" min. | 670 RPM | GOOD |



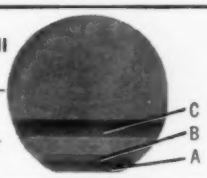

## IRON

**Grey Iron CL-30** — **200 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16½" min. | 800 RPM | GOOD |
| B | 10½" min. | 800 RPM | VERY GOOD |
| C | 7⅛" min. | 800 RPM | EXCELLENT |

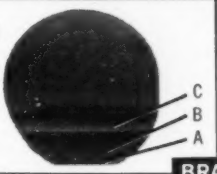
**Grey Iron CL-40** — **210 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16½" min. | 800 RPM | GOOD |
| B | 10½" min. | 800 RPM | GOOD |
| C | 7⅛" min. | 800 RPM | EXCELLENT |



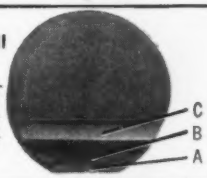

**Ductile Iron 60-40-15** — **132 Brinell**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16½" min. | 800 RPM | GOOD |
| B | 10½" min. | 800 RPM | GOOD |
| C | 7⅛" min. | 800 RPM | VERY GOOD |




**Ductile Iron 100-90-02** — **160 Brinell**

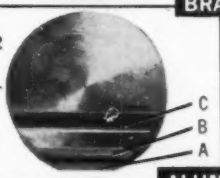
| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16½" min. | 800 RPM | EXCELLENT |
| B | 10½" min. | 800 RPM | EXCELLENT |
| C | 7⅛" min. | 800 RPM | EXCELLENT |




## BRASS

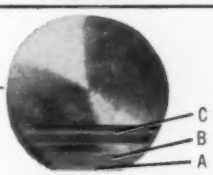
**Tobin BRZ** — **Alloy 452**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16⅛" min. | 800 RPM | GOOD |
| B | 13½" min. | 800 RPM | GOOD |
| C | 7⅛" min. | 800 RPM | EXCELLENT |




**Brass Alloy 271**

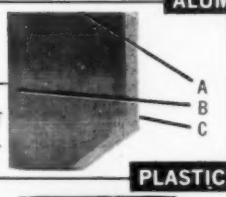
| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 16⅛" min. | 1240 RPM | EXCELLENT |
| B | 13½" min. | 1240 RPM | GOOD |
| C | 7⅛" min. | 1240 RPM | FAIR |




## ALUMINUM

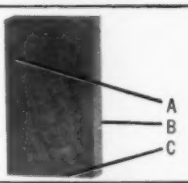
**7075 Aluminum**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 60¾" min. | 2400 RPM | FAIR |
| B | 16½" min. | 2400 RPM | EXCELLENT |
| C | 10½" min. | 2400 RPM | SUPER FIN. |




**2024-T4** — **Aluminum**

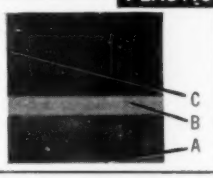
| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 60" min. | 2400 RPM | GOOD |
| B | 30" min. | 2400 RPM | GOOD |
| C | 10½" min. | 2400 RPM | VERY GOOD |




## PLASTIC & FIBER

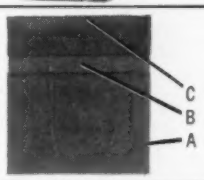
**Material** — **Linen "L"**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 150" min. | 1000 RPM | VERY GOOD |
| B | 30" min. | 1000 RPM | EXCELLENT |
| C | 16½" min. | 1000 RPM | GOOD |



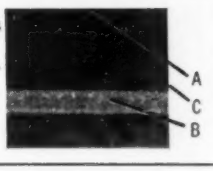

**Material** — **NAT XXP**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 150" min. | 1000 RPM | VERY GOOD |
| B | 20" min. | 1000 RPM | EXCELLENT |
| C | 20" min. | 1000 RPM | EXCELLENT |



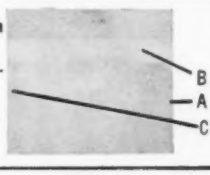

**Material** — **AA 79 Asbestos**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 150" min. | 1000 RPM | GOOD |
| B | 30" min. | 1000 RPM | VERY GOOD |
| C | 15" min. | 1000 RPM | EXCELLENT |




**Material** — **Nylon**

| | FEED | SPEED | FINISH |
|---|---|---|---|
| A | 60" min. | 1000 RPM | GOOD |
| B | 30" min. | 1000 RPM | VERY GOOD |
| C | 16½" min. | 1000 RPM | EXCELLENT |




**NEW VERSATILITY CUTS GENERAL PURPOSE TOOL INVENTORY . . .**

These shop tests and many others indicate that the Thriftmill is not just another end mill. It is an engineering breakthrough in cutting tool design that promises **major, new production** and economy benefits.

Send for Catalogs and Prices on the complete B&S Cutting Tool Line. Start applying tooling savings and cutting tool performance bonus to your production NOW!

Thriftmills Made in U.S.A.

**ALL THESE BENEFITS AND 20% LOWER INITIAL TOOL COST!**

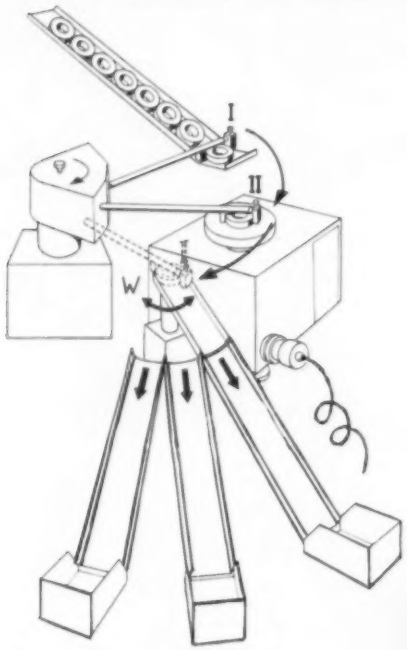
*For that EXTRA Edge in Production!*

'61
BOOTH No. 1315

**Brown & Sharpe**

Cutting Tool Division
Brown & Sharpe Mfg. Co.
Providence 1, Rhode Island

# Mettler EQUIPMENT FOR AUTOMATIC WEIGHING



Schematic drawing of check-weighing and sorting operation.

Check-weighing and sorting of machined parts at rate of up to 60 per minute.

Weighing accurate charges of metal powder—directly into die cavity—at rate of 10 to 15 per minute.

METTLER invites you to see this modern equipment in Booth No. 3711, 1961 ASTME Tool Exposition, Coliseum, New York, N. Y., May 22 to 26.

**METTLER INSTRUMENT CORPORATION**
**P. O. BOX 100, PRINCETON, NEW JERSEY**

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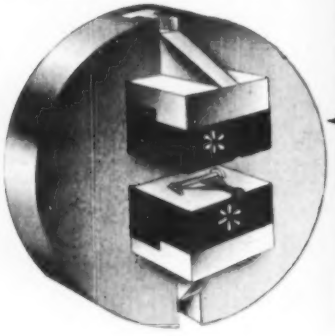
## Make Holding Fixtures Quickly / Easily with EPOCAST



- Absorbs Inertia
- Eliminates Tool Chatter
- Compensates For Casting Variance
- Accurate
- Fast
- Protects Parts From Marring
- Inexpensive

*EPOCAST is an ideal material for making holding fixtures such as the plastic chucking jaws shown here. It casts in three simple steps. Sets tack free in 2 to 4 hours. Ready for use in 24 hours or less. Makes tooling easier. Send now for technical bulletin giving full information on making chucking jaws.

**furane plastics**
INCORPORATED

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Save Time!
Test Accurately!

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**HARDNESS TESTERS**

Frequent hardness testing of metals before and during fabrication and after heat treating is essential today for best results.

Ames Portable Hardness Testers answer the need for a light weight, accurate, dependable tester that may be carried to the work for on-the-job testing. They are easy to use, require no skill, and get speedy, accurate tests wherever the work may be—no delays, no cutting off specimens—no waiting for laboratory tests.

Besides testing flats, rounds, tubing, etc. Ames Hardness Testers make tests that otherwise would be impossible, such as large gears, knives, saws, blades, struts, frames and assembled parts. Thousands are in use paying for themselves over and over again in time and materials saved.

*Send for a free bulletin.*

**AMES PRECISION MACHINE WORKS**
Waltham 54, Mass., U.S.A.

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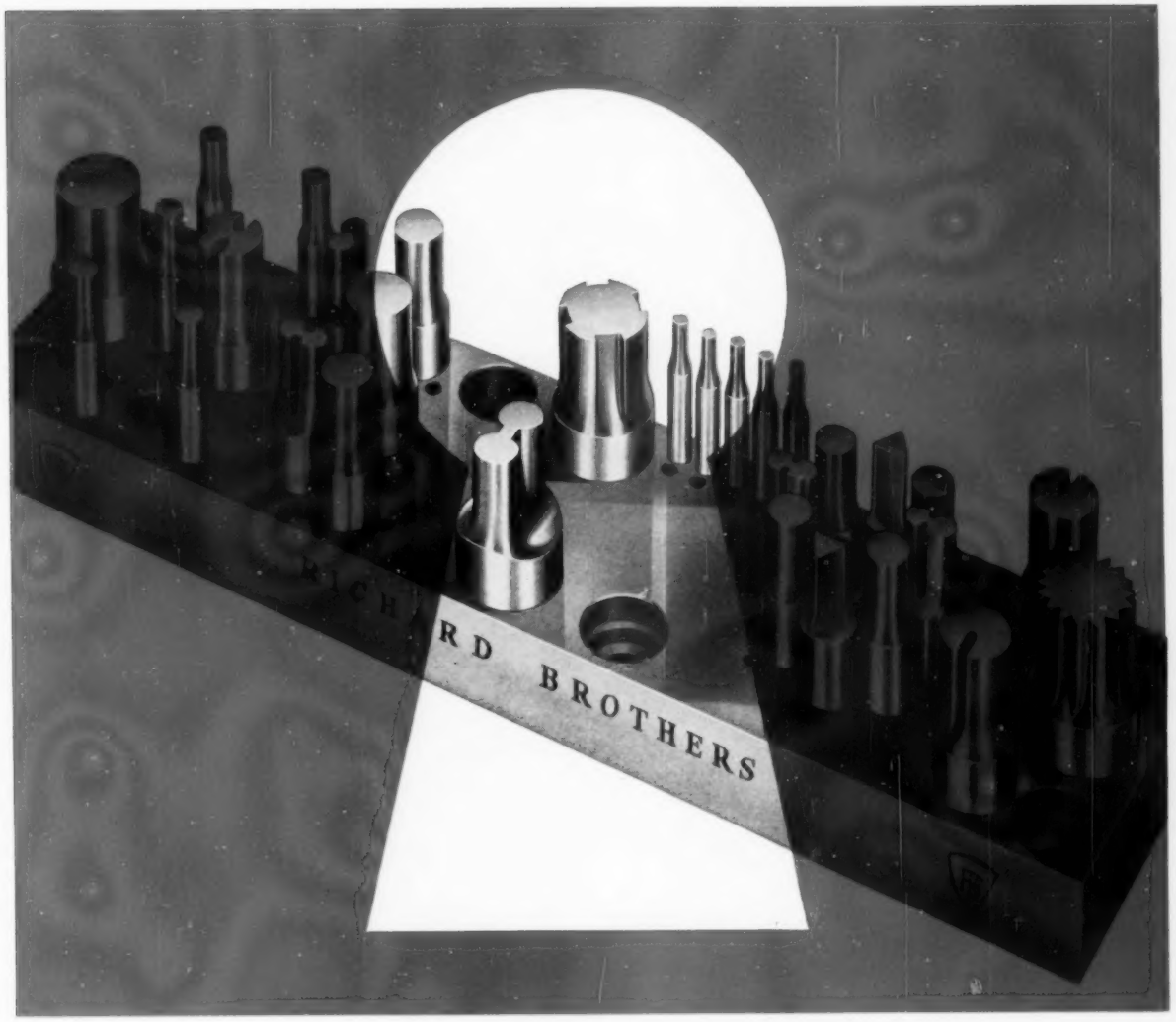


# KEY TO EFFICIENT, ECONOMICAL OPERATION

In any sheet-metal piercing operation where frequent tool change is required, Richard Brothers standardized interchangeable tooling can be the key. Complete interchangeability of standard or special punches and die buttons within the same RB retainers saves time, cuts costs.

You save design time by applying RB standardized features. You save die construction time because RB tools are ready to use. You save press down-time because RB tools are so easy and quick to change—yet positive alignment is assured. And Richard Brothers tools meet the highest standards of the industry because of the finest quality control of materials, heat treating, machining and inspection.

Specify Richard Brothers punches, die buttons and retainers for more efficient, economical operation.

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RELIABILITY

INTERCHANGEABILITY

COMPLETE STOCK

## RICHARD BROTHERS PUNCH DIVISION

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# Push up the output
## *with RESINALL belts*

DOWN goes production time and up go profits. That's the story time and time again with Behr-Manning *resin*-bonded* belts and discs. There's less breakdown from heat and loading; more and better cutting per belt dollar.

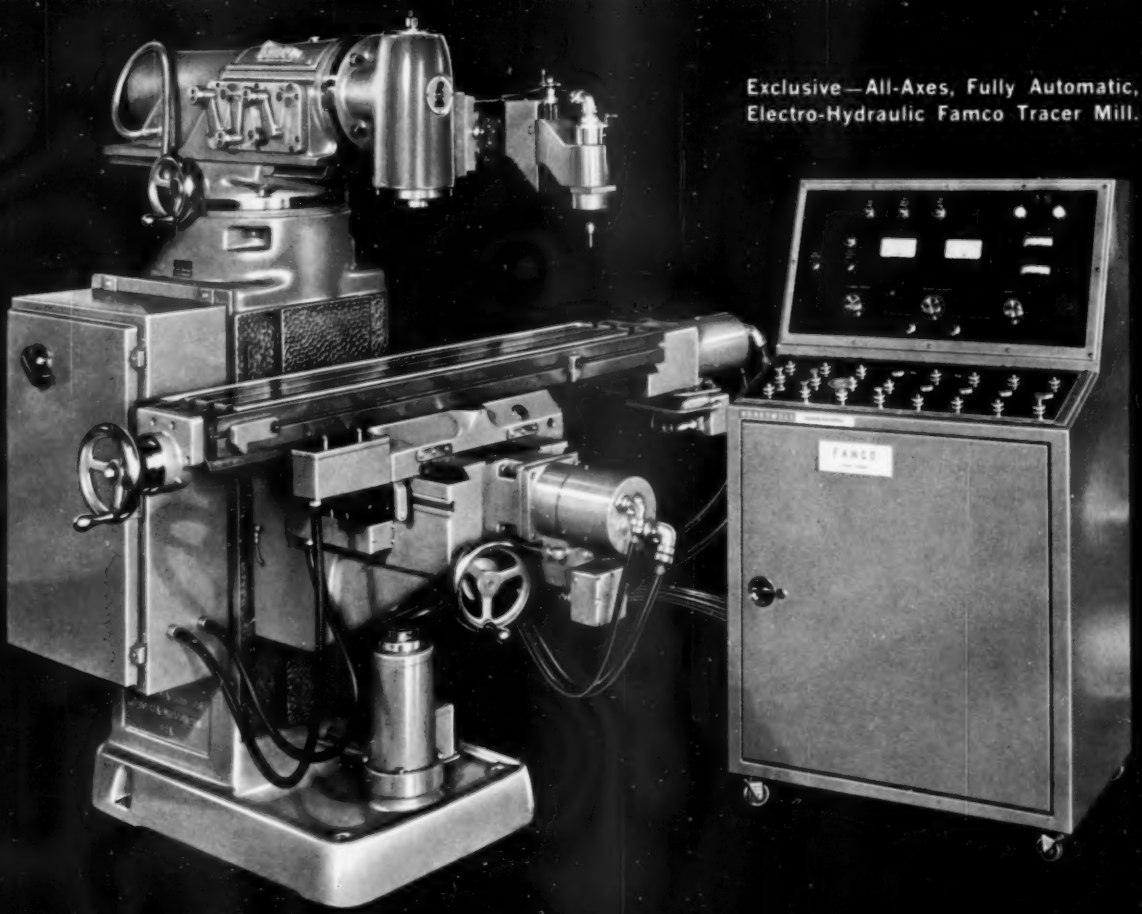
We can prove it . . . and will. Just ask for an in-plant demonstration. Write Dept. TE-5, BEHR-MANNING CO., Troy, N. Y., a division of Norton Company.

***RESINALL** . . . an all-resin-bonded aggressive belt of strong X-weight cloth, for maximum heat resistance in most all rough and intermediate grinding operations.

***RESINIZED** . . . a resin-over-glue belt of good heat resistance, in strong X-weight for flat polishing, and in flexible J-weight for contour polishing.

(Guard has been removed from machine for photo.)

® BEAR BRAND *Abrasives*

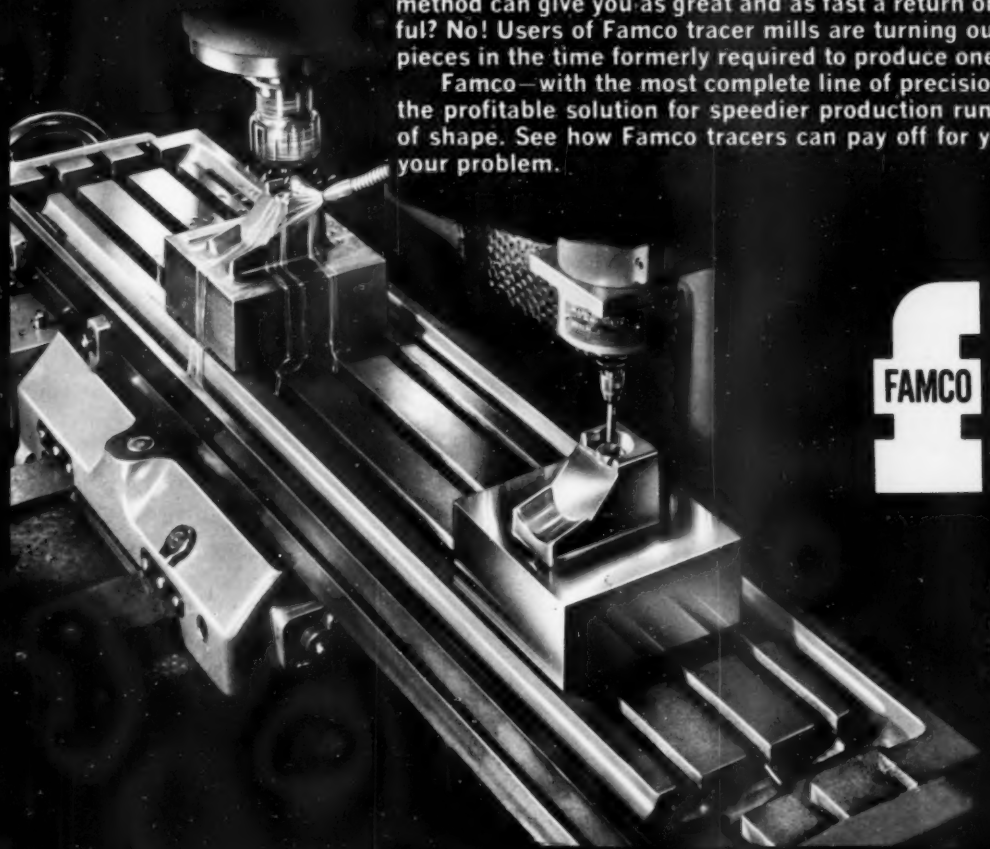


Exclusive—All-Axes, Fully Automatic, Electro-Hydraulic Famco Tracer Mill.

## RUN OR DIE

No other machine tool handles production runs of intricate parts—die and mold work, too—as speedily and efficiently as a Famco tracer mill. No other method can give you as great and as fast a return on your investment. Boastful? No! Users of Famco tracer mills are turning out 3, 5, 10 and even more pieces in the time formerly required to produce one.

Famco—with the most complete line of precision tracer mills—offers you the profitable solution for speedier production runs or die work, regardless of shape. See how Famco tracers can pay off for you. Just write and tell us your problem.



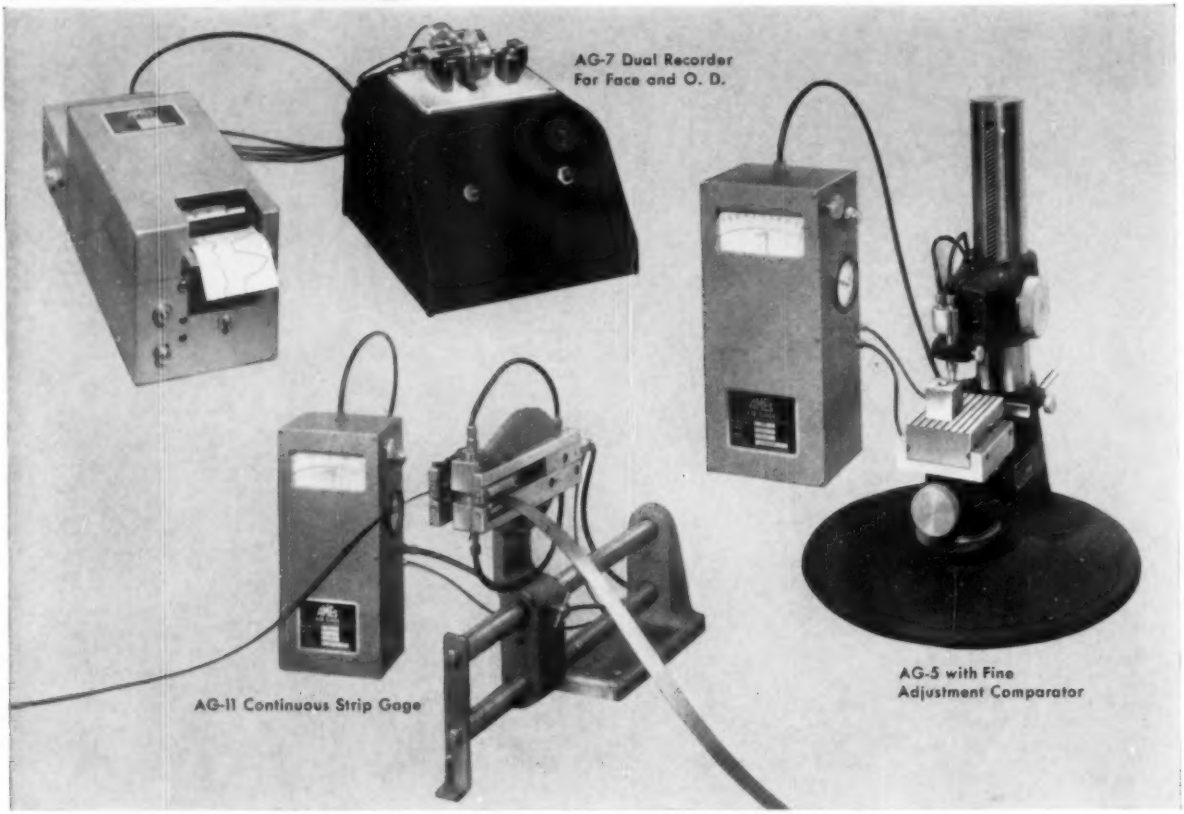
**FAMCO MACHINE COMPANY**

Kenosha 2, Wisconsin

*Products of Famco*

Milling Machines—Presses: Air, Hydraulic, Foot, Power, Arbor—Squaring Shears—Band Saws

# AMES *Masters of Measurement*




## ACCU-FLOW AIR GAGING EQUIPMENT

The new line of ACCU-FLOW air gages developed by B. C. Ames includes several patented components, including nozzles and pressure indicators, which give these gages unusual range and exceptional linearity.

***Special Models are Available for Checking:*** outside and inside diameters, center distances, flatness, roundness, hole depths and continuous non-contact measuring or comparing of paper, metals, plastic films, etc.

Ames ACCU-FLOW Air Gages are providing the answer to many measuring problems that were once considered impossible to solve. For complete information on the entire line of Ames air gaging equipment, write for new ACCU-FLOW folder. *You're asking for the best when you specify Ames!*

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# BEST BUY
## IN THE COMPACT FIELD TODAY

# NEW WATTS
## FILTER – REGULATOR – LUBRICATOR

You know what it's like to design a system and then find oversized components driving weight and costs up.

*But no more.* Now you can specify this compact Watts assembly for applications where (1) space is limited or (2) you have low flow requirements.

You don't sacrifice a thing! Dependable Watts filter has 20 micron porous bronze element. Exclusive Watts by-pass principle gives optimum lubrication at flow rates from .2 to 15 CFM with negligible pressure drop. Fill plug and oil feed adjustment are interchangeable front to rear. Maximum pressure is 150 PSI. Two sizes — ⅛" and ¼".

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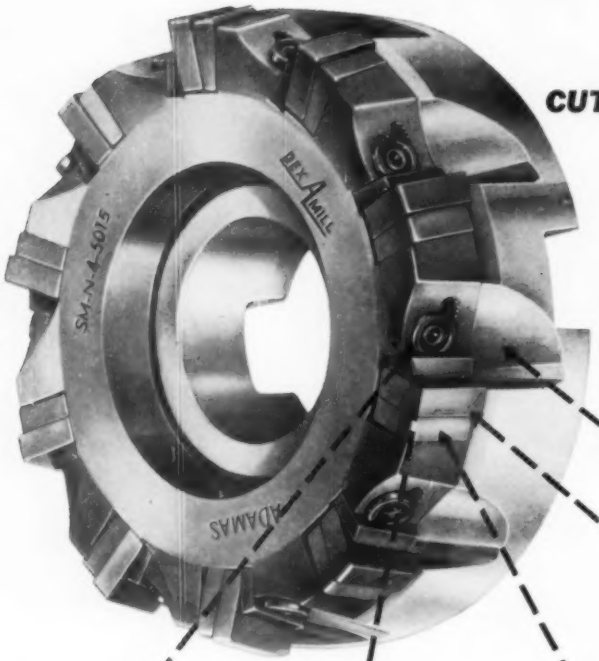
**Visit Watts Booth 2006 ASTME Tool Exposition**

# Introducing DEX A MILL

**...THE NEW INDEXABLE MILLING CUTTER BY ADAMAS THAT GIVES YOU:**

- **GREATER ACCURACY to produce finer finishes**
- **MORE TEETH to remove more metal**
- **SUPERIOR DESIGN to give longer carbide life**



**POSITIVE LOCK**

Adamas Dex-A-Mill features the powerful combination of positive lock on top and carbide anvil under carbide insert. Securely locks, easily unlocks with a partial turn of a wrench.

**CARBIDE CHIP DEFLECTOR**

Protects cutter body from chip erosion—Chips strike long-wearing carbide deflector instead of body or locking mechanism.

**THICK CARBIDE ANVIL**

For maximum rigidity and insert support . . . permits higher feeds and speeds . . . protects cutter body from damage.

**THROWAWAY CARBIDE INSERTS**

Inserts are quickly and accurately indexed or replaced on the machine with the cutter in position. Eight individual cutting edges on each insert eliminate costly regrinding.

**WIDE, DEEP CHIP SPACE**

Allows maximum metal removal—permits heavier cuts . . . Eliminates possible damage to cutter due to loading of chips.

Greater accuracy is built-into the rugged, heat-treated alloy steel body of this top performing milling cutter for throwaway inserts. Its 2-piece construction enables insert seats to be uniformly ground to extremely close tolerances assuring consistently superior performance. DEX-A-MILL's greater number of teeth per cutter diameter permit fast, low-cost milling operations with inexpensive, indexable, throwaway carbide inserts. Right and left hand cutters are stocked in both shell end mill and face mill designs with double negative rake angles and 15° lead angle. Standard size diameters range from 3" to 12" . . . Special cutters subject to quotation.

● *For full details, write for your copy of Bulletin DM-860.*

Producers of:
Tungsten Carbide Tools
Tool Tips
Dies, Wear Parts
Dex-A-Tool
Dex-A-Mill

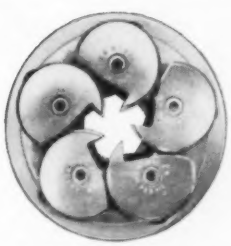
**ADAMAS CARBIDE CORPORATION**
KENILWORTH, NEW JERSEY

PROGRESSIVE CARBIDE USERS SELECT BY *Performance*...NOT HABIT!

# NAMCO's FIVE CHASER Vers-O-Tool...

## Lear Romec's Solution To Tough Threading Tolerances

Charles Van Auken, Assistant Chief Production Engineer at Lear Romec Division of Lear, Inc., Elyria, Ohio tells us: "Threading specs for this lock-nut for a jet engine vane pump are tough . . . 1⅛—12N —3A, +.0000 and —.0045 on pitch diameter, 100 RMS on surface finish. Naturally, we use a NAMCO 5-Chaser Vers-O-Tool. It consistently surpasses the specs and sets up in a *fraction* of the time required for a 4-chaser tool. On threading jobs like this, the 5-Chaser Vers-O-Tool is our margin of profit!" Anyone who has ever used a NAMCO 5-Chaser Vers-O-Tool will agree. There just isn't anything that threads better. And, there are good reasons . . . all outlined in our new Bulletin DV-1 "Five Circular Chaser Threading". At your request, we'll be happy to send you a copy.



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198 E. 131st STREET
CLEVELAND 8, OHIO

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## NOT JUST SPEED ALONE ... BUT SPEED PLUS...

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** 1/8-inch High Speed Cold Header 27,000 Parts Per Hour*

Ask to see our 16mm color sound film, "High Speed Cold Heading."

*Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS*

# NATIONAL MACHINERY CO.

*TIFFIN, OHIO, U. S. A.*

**HARTFORD** **DETROIT** **CHICAGO**

- MACHINES UP TO 50% FASTER
- LENGTHENS TOOL LIFE

Uniloy 303MA is a free machining grade of chromium-nickel stainless steel developed by Universal-Cyclops. It has been proven greatly superior to AISI Type 303 in key plants throughout the country.

Production tests have proved that Uniloy 303MA machines up to 50% faster than Type 303. Cutting tools last longer, decreasing tool cost and machine down time. Completed parts have a better finish than is possible with Type 303, and the corrosion resistance is far superior.

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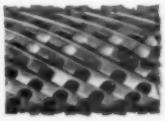
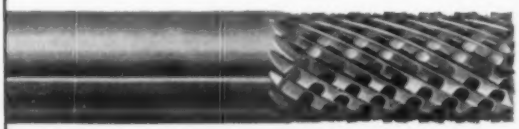
## DIXIE CARBIDE ROUT-O-MILLS



EFFICIENTLY ROUT, MILL AND TRIM THE HARDEST, MOST ABRASIVE **PLASTICS**



Custom designed Dixie Carbide Rout-O-Mills rout, mill and trim "hi-hard" plastics such as reinforced fibreglass, melamine, Plexiglas, Expoxys and laminated plastics. Exclusive tooth designs provide much faster cutting speeds and considerably longer tool life.

Carbide Rout-O-Mills are available in 1/16 to 1½ inch diameters . . . and tooth designs in many contours are available. Send for Rout-O-Mill Bulletin.

Contact Dixie Tool Industries for machining and engineering assistance in plastics fabrication.

Complete Carbide Tool catalog available upon request.

DIXIE

**Dixie Tool Industries, Inc.**
**Bridgeport 4, Michigan.**

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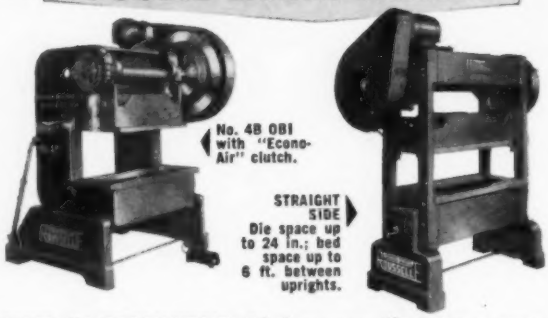
### DOUBLE-CRANK PRESSES

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**DEMAGNETIZERS**
Instantly demagnetize tools or production parts. No moving parts. 110 v., 60 cy. A.C.

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**RECTIFIERS** A.C. input 110 volts; D.C. output 110 volts. P-1 for 5¼" x 13" chuck 0.8 amps. $57.50
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P-3 for 8" x 24" and 10¾" x 37" chuck 3.0 amps. $87.50

**DEMAGNETIZING SWITCHES** For 5¼" x 13" and 6½" x 18" sizes. $15.00
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**LATHE**
Heavily ribbed, semi-steel cast body. Ground face and outside diameter. Solid steel hardened and ground jaws. T Hand Wrench included.

4-JAW INDEPENDENT 6"/8"/10"/12"/14"
Reversible jaws, wide gripping surface. Tough, oversize hardened alloy steel screws with accurately cut square threads. Hardened alloy steel anchor bearings.

3-JAW UNIVERSAL
Guaranteed to run true for lathe or screw machine work. 6", 8" and 10" sizes come complete with two sets of accurately fitted jaws, male and female. 5" size has body threaded 1¼" x 8" (or can be furnished for use with adaptor plates) and comes with one set of 3 reversible jaws. One high grade hardened steel pinion used on 5", 6", and 8", 3 on 10" size. Special alloy scroll.

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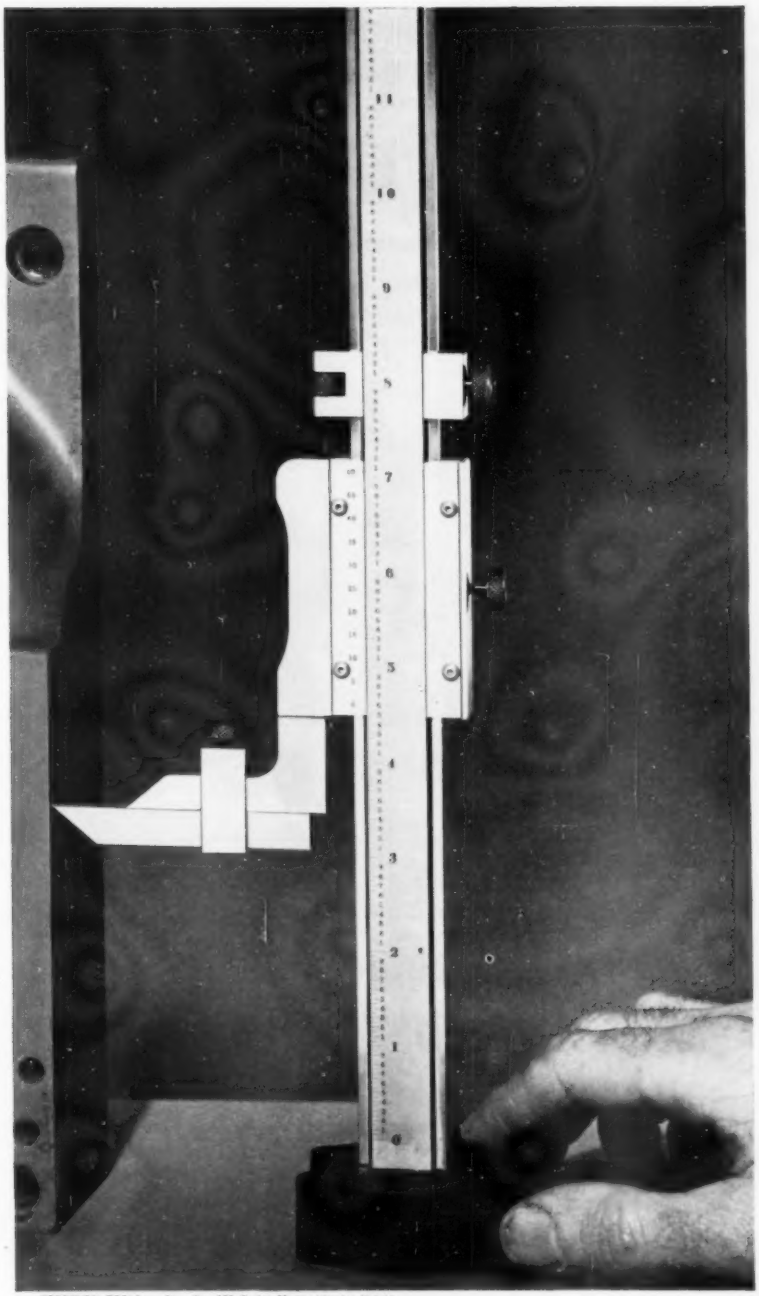

PRECISION TOOLS — New No. 255 Series Master Vernier Height Gage. Available in 12" and 18" SIZES.

# NEW lighter weight Starrett® SATIN-CHROME master vernier height gage

In the new, popular priced, No. 255 Series Flush-Reading Master Vernier Height Gage, Starrett presents a lighter weight companion to the No. 254 heavy duty Master Vernier Height Gage.

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*World's Greatest Toolmakers*

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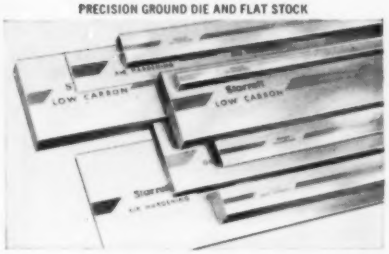


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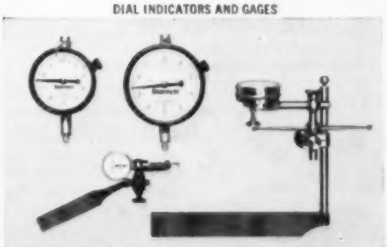

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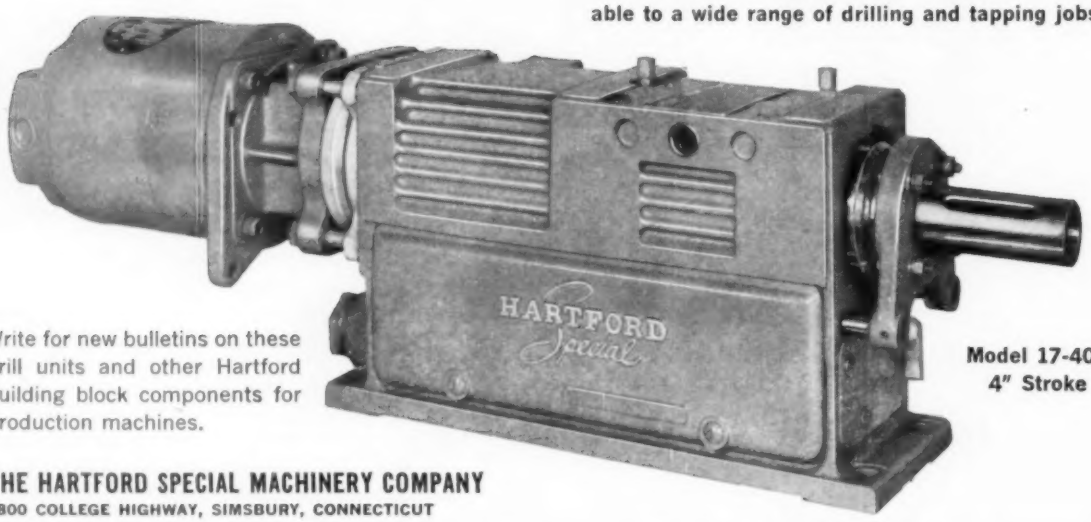
HARTFORD Special

# DRILL UNITS for VERSATILITY

**Easy adjustment of feed rate and stroke length makes Hartford air-hydraulic units quickly adaptable to a wide range of drilling and tapping jobs.**




Write for new bulletins on these drill units and other Hartford building block components for production machines.

**Model 17-400**
**4" Stroke**

**THE HARTFORD SPECIAL MACHINERY COMPANY**
3800 COLLEGE HIGHWAY, SIMSBURY, CONNECTICUT

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CINCINNATI SUB-ZERO CHAMBERS feature

# RUGGED CONSTRUCTION

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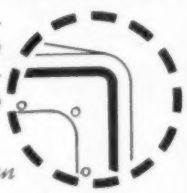

*Custom Engineered Design*

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- Unitized all-metal with no seams; electric welded
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- Phosphatized, to prevent rust
- Easily removable, expanded metal grille guards, for quick access to refrigeration system

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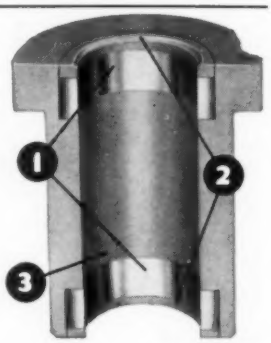
*A Cost Saving*

# BUSHING STORY IN A NUT SHELL

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**1.** Tungsten carbide rings at the points of wear; **2.** Steel rings protect drills and carbide; **3.** Special hardened alloy steel body; **4.** Performance: same as solid carbide, but need not be handled with kid gloves; **5.** Greatest economy, because of maximum life at minimum cost; **6.** Enjoy the advantages of greater accuracy for a longer time, less spoilage, less machine down-time, added drill and jig life with MEYCO carbide inserted drill jig bushings.

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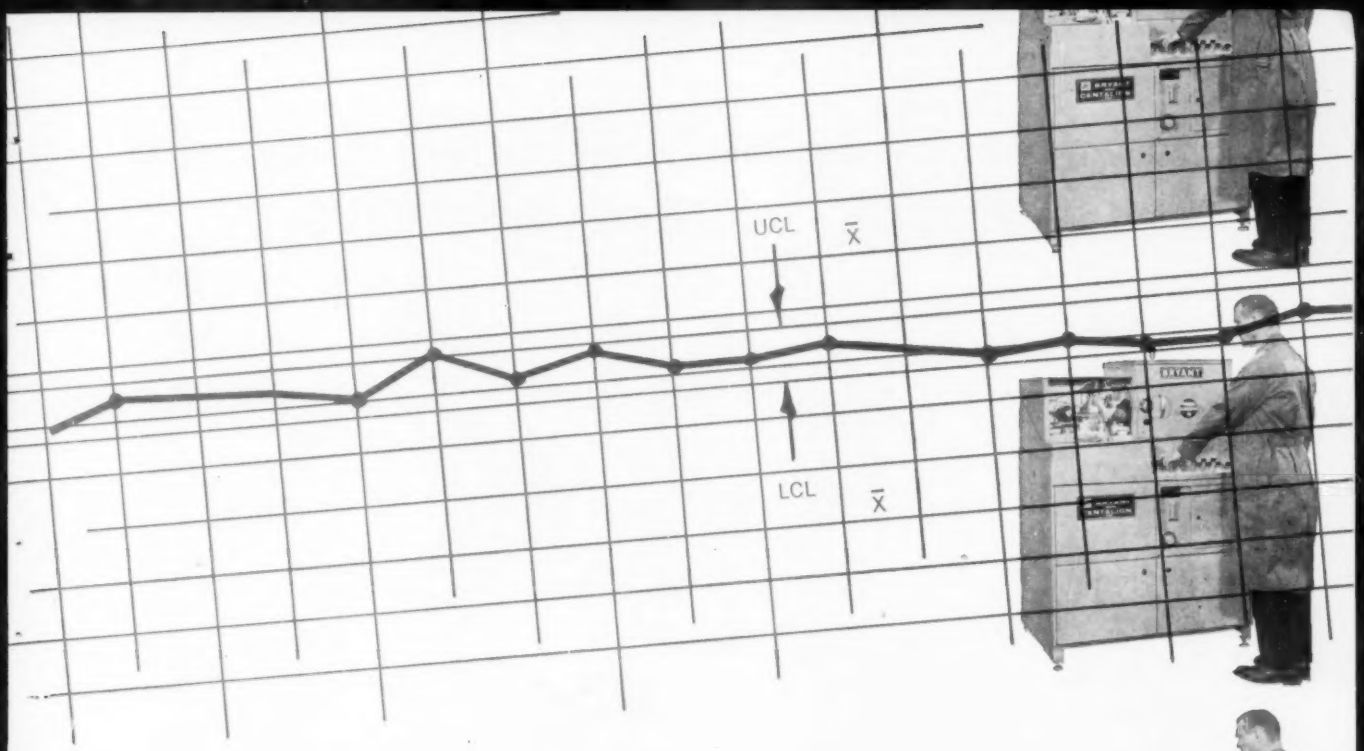


# TEST CURVES LIKE THIS

# PROVE OUT

# BRYANT GRINDERS

The test curve above is typical. It shows the average size variation of the I.D. in a run of sample parts ground to customer specifications on a Bryant Internal Grinder. From this curve and other data, Bryant engineers evaluate the machine's *long term* precision capabilities, using mathematical laws of probability. Result: a job-engineered machine, tested under actual production conditions — *proved out* by statistical quality control methods. Logical reasons why a Bryant Production Internal Grinder is best suited to maintain the required quality standards in *your* plant. Contact your nearest Bryant or Ex-Cell-O sales representative for full details.

This Model "B" Centalign® provides quick changeover and high precision on short or long production runs of small workparts.

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## Chucking Grinder Co.

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# YOUR ONE SOURCE SUPPLIER

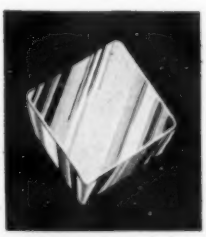
Negative rake indexable insert milling cutters

Clamp-type throwaway-insert tool holders

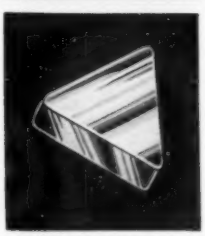
Staggered tooth inserted blade HSS milling cutters

Positive rake indexable insert milling cutters

Throwaway-insert boring bars



Half side inserted blade milling cutters



All sizes and types of throwaway-inserts: HSS; cast alloy; carbide; ceramic. Send prints for quotations on Negative and Positive rake inserts.

## ONE FOR ALL ... ALL FROM ONE

The wise way to buy Carbide, High Speed Steel, Cast Alloy and Ceramic Throwaway-Inserts, and Tool Holders, Milling Cutters, and Boring Bars is to buy from *one* knowledgeable source. Viking tool engineers know the applications of not merely *one* of these items, but of *all* of them as they so vitally relate to each other in order to obtain maximum cutting performance with minimum loss in time and materials. Because Viking engineers are *pioneers in the throwaway-insert and tool industry,* they are uniquely able to recommend the right tool and/or insert for your particular need. They are at your service.

**ASK FOR AN INTRODUCTION**

Viking TOOL CO.

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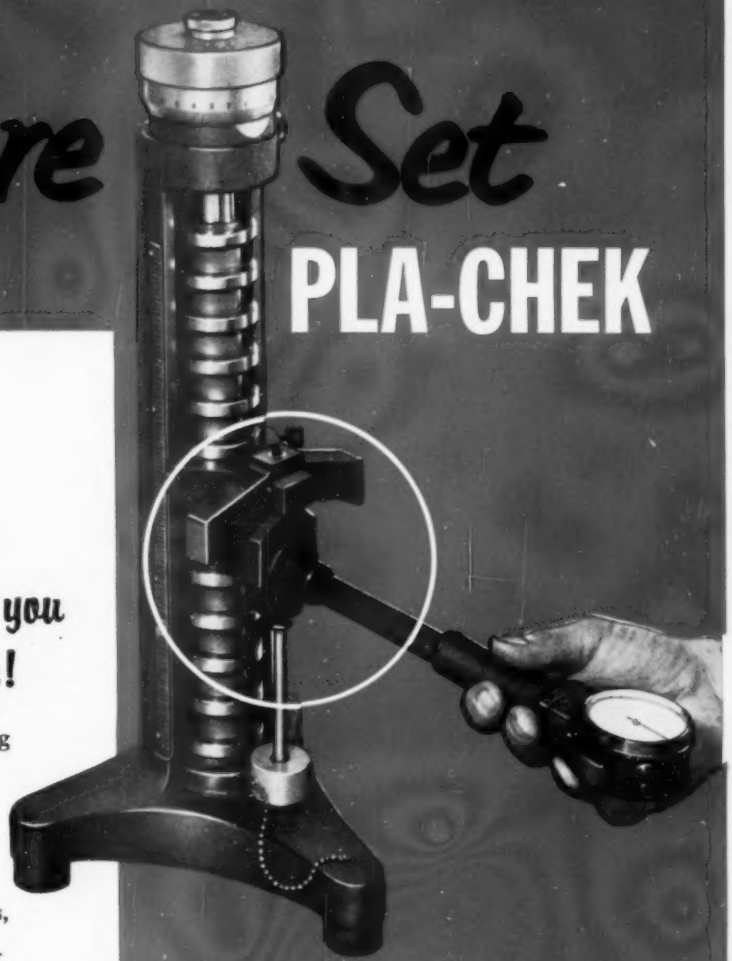
# with this NEW Cadillac Bore Set PLA-CHEK

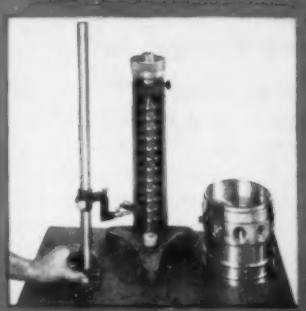


## You can set:

**DIAL BORE GAGES**
**INSIDE MICROMETERS**
**TELESCOPING GAGES**
**INTERNAL CYLINDER GAGES**

## . . . much faster than you can read this page!

It's true! Time-saving is one of the big features of this new Cadillac Bore Set PLA-CHEK. Guaranteed accuracy is another! Designed especially to save time, money and to provide extreme accuracy in the setting and checking of Dial Bore Gages, Inside Micrometers, Telescoping Gages and Internal Cylinder Gages, this new PLA-CHEK is guaranteed to .000050". No gage blocks need be used and, in most cases, ring gage setting masters are not necessary. This new PLA-CHEK is the result of over 16 years' experience in the building of high-precision PLA-CHEK Gages. It is designed for easy portability on the job so that it may be used either on the surface plate or at the machine. Write, wire or telephone TODAY for prices and additional information.



**Use it as a regular PLA-CHEK, too!**

You get a two-for-one value with the new Cadillac Bore Set PLA-CHEK. It is also a regular 13" self-contained PLA-CHEK Gage for use on all checking and inspection jobs where extreme accuracy is important and where speed is essential. The Bore Gage Set Block assembly may be removed or it may be used as a reverse checking plate. Other PLA-CHEKS include the 6", 12", 18", 24", 36" and 48" models.

**Cadillac GAGE COMPANY**

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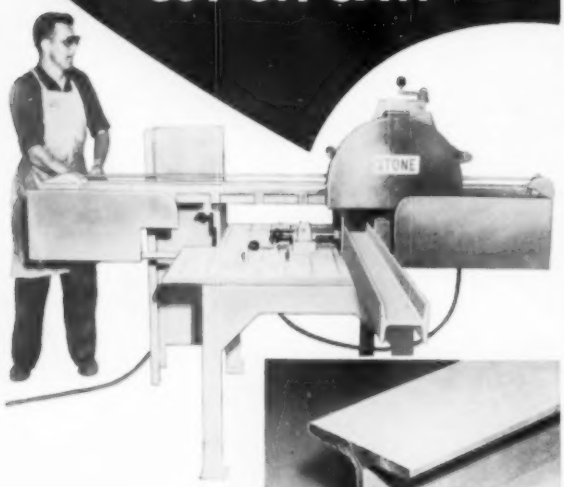
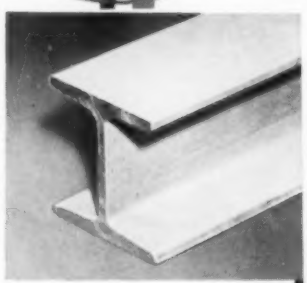
# Just 33 Seconds to Cut 6" H-Beam

## STONE SS-100-LR TRAVERSE TYPE CUT-OFF SAW





6" x 6" x ¼"
15.5# H-BEAM

This 6" structural H-Beam is cut in a single, 33-second pass at the Syracuse Engineering Company. For precise, square and clean cuts with economy of speed and wheel wear, Syracuse Engineering depends on this Stone Model SS-100 LR with the geared-in-head motor that develops full 10 HP. The 22" semi-hi-speed steel friction blade gives up to 1000 cuts per sharpening.

There's a Stone cut-off machine to fit every production line or machine shop requirement. Choose from manual, semi- or fully-automatic chop-stroke or traverse type machines. Steel, friction or abrasive wheels are available to cut ferrous or non-ferrous metals such as bar, pipe, tube, structural, sheet or plate.

**Discover the profit possibilities of a Stone high-speed, cut-off machine in your plant. Write or phone for full details.**

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**Hold positive hole location tolerances**

ZIEGLER TOOLS

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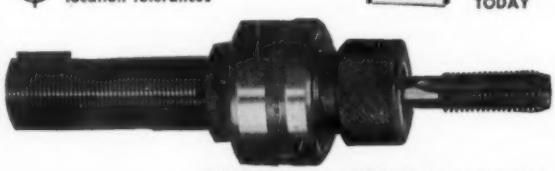

**SIZES and types to fit all machines used for tapping and reaming.**

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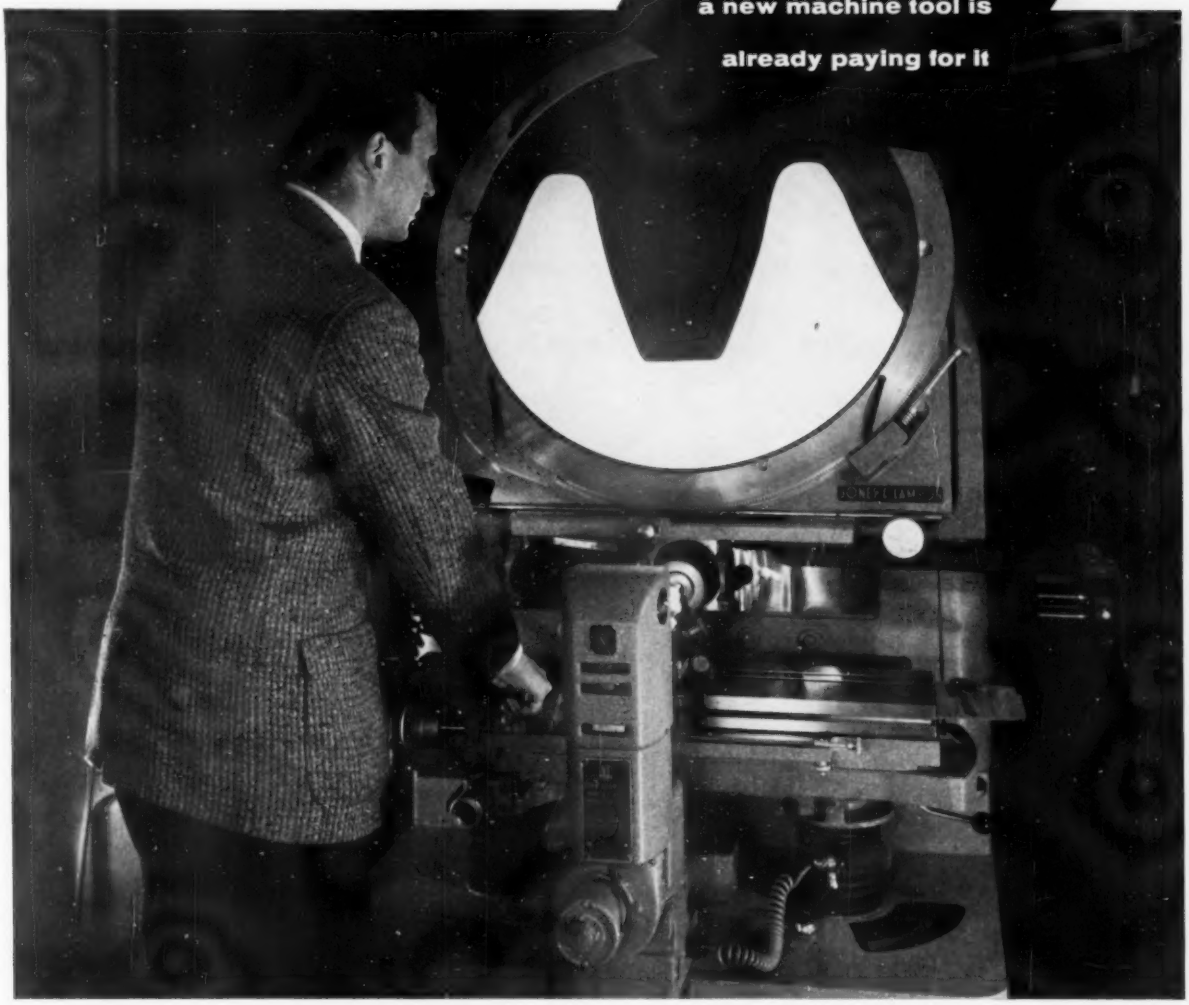
# OPTICAL COMPARATORS

the man who needs
a new machine tool is
already paying for it



## This revolutionary new light source makes optical inspection more efficient than ever

Jones & Lamson now offers the J & L Mercury Arc Lamp, an entirely new light source unit that gives *more than 5 times the intensity of the best filament light source available today.*

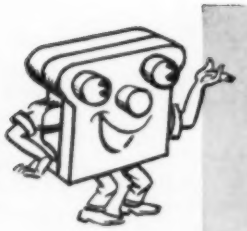
This new unit, designed for use with any J & L 14-inch or 30-inch screen Comparator, actually gives a *new* kind of light . . . an extremely bright, *steady* arc, with *no* flickering. Its high intensity produces an incomparably bright screen with razor-sharp black shadow, even at highest magnifications.

Thus, you can greatly increase the accuracy of your inspection and measuring with the J & L Comparator, even to the point of actually "splitting tenths". (For use at low magnifications, the light can be filtered readily.)

The J & L Mercury Arc Lamp comes as a complete, compact packaged unit, which plugs into any 110 volt outlet. It is quickly interchangeable with the standard light source of any Jones & Lamson 14-inch or 30-inch screen Comparator, and is a universal device which accomodates various standard makes of mercury arc lamps.

For detailed information and specifications, or a demonstration, contact your local J & L representative or write direct to Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



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In all types and sizes — with or without special machine work.

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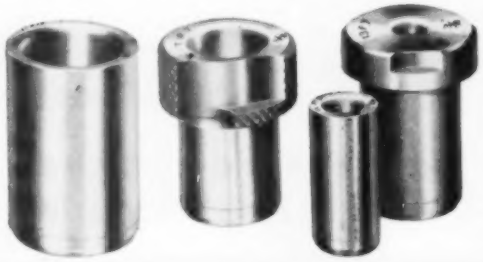

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**"THREE MACHINES —one basic unit"**

1. HAND LOADING
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**FEATURES:**

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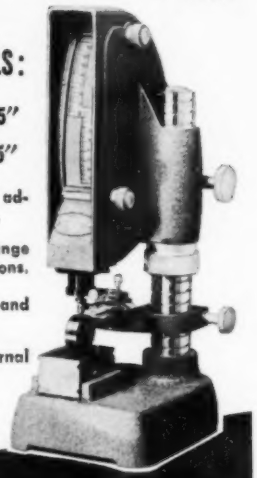

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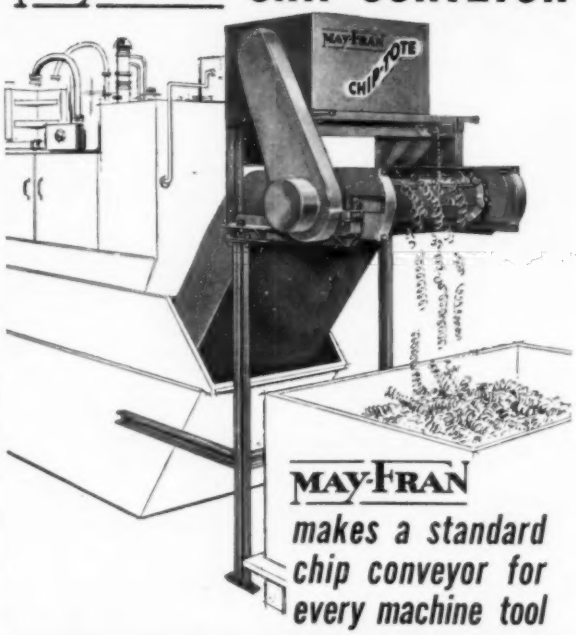


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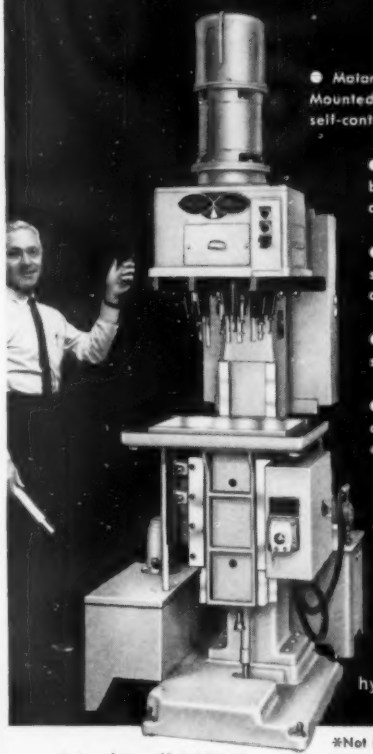
new! UP TO 60 TAPPING CYCLES A MINUTE!



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ONLY $6,050.00 F.O.B. Factory. A low cost leasing plan also available.

hydraulically powered

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## HI-SPEED DRILL UNITS

for holes from .020" to 1/4"

## ADVANTAGES

Faster, higher, lower-cost hole production —especially in aluminum, magnesium, fiberglass, glass-filled plastics and wood.

Cleaner, burr-free holes—low pressure at high speed reduces material upset on drill break-through

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For drilling, small rivet spinning, friction welding and related work

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800 to 15,000 rpm spindle speeds.

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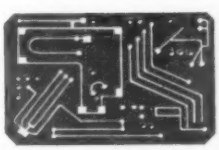
*3-phase motor available



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No waiting for special, custom equipment. See him **now** for a demonstration . . .

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*for nut setting . . .*

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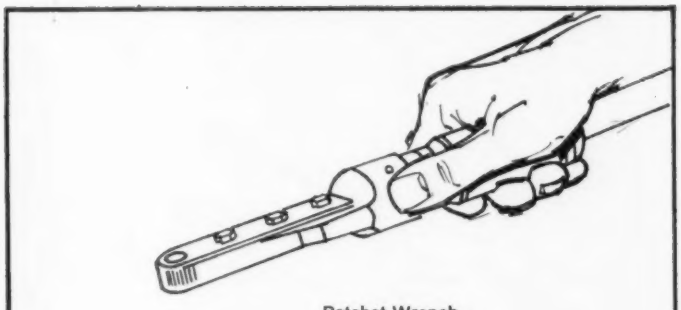
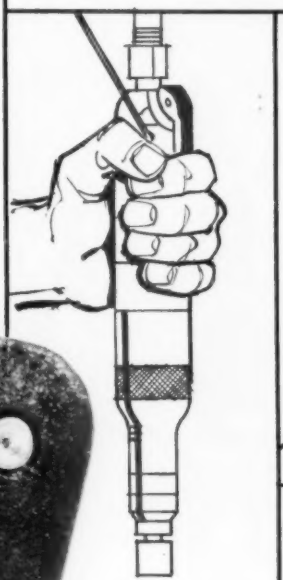
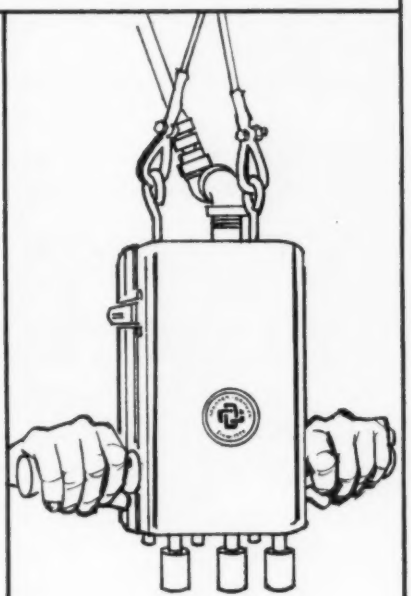


Ratchet Wrench



In-line
Nut Setter



Multiple Nut Setter

# *with the right air tools*

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

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**High Speed Steel, Carbide Tipped or Solid Carbide**

# DRILLS REAMERS CUTTERS

***Especially designed and manufactured TO MEET YOUR NEEDS!***

Fine craftsmanship and high quality standards are the company policy and the creed of each man at Special Drill and Reamer Corporation. It is such dedicated effort that accepts no substitute—builds customers and makes lasting friends.

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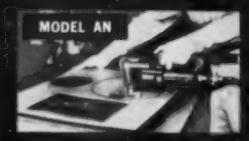
# VERSATILE PORTABLE NIBBLERS



## . . . CUT METALS* RIGHT ON THE JOB!

No matter the kind of metal or shape to be cut, FENWAY NIBBLERS (air powered or electric) operate with a cutting action which displaces the metal without distortion on both sides of the sheet: insures finished smooth edge, no chipping, no binding, no curling, no flaking . . . Cuts inside circles, squares, odd shaped holes on a per job or production line basis—saves time and materials in every application . . . Portable, light in weight, (8-20 pounds depending on model) —safe, easy to handle, proved durable in critical operations, minimum maintenance, guaranteed unconditionally.

*THE FENWAY NIBBLER CUTS: All non-ferrous metals, copper, brass, aluminum, etc. 10 gauge stainless steel and lighter; 8 gauge mild steel and lighter; tough pitch or asbestos coated corrugated steel ¼" cold or hot rolled steel and 5/16" aluminum.

**Write Today for Complete Specifications, or Free Demonstration in your area**

**FENWAY MACHINE CO. INC.**
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# *Easy to handle*

## SAFE and ECONOMICAL, too!

**HANSFORD DIE HANDLER**

**WRITE TODAY for FREE Literature**

How would YOU like to save *100 hours* in making an average die, *25 hours* in an average repair job, and *3 hours* for simple inspection? Now it can be done with the Hansford Die Handler. Reason? It's a one-man operation. No chain hoist or lead mallet. Accurate and time-saving.

Illustrated and detailed specifications on 8 models with 20 variations for dies weighing up to 6,000 lbs.

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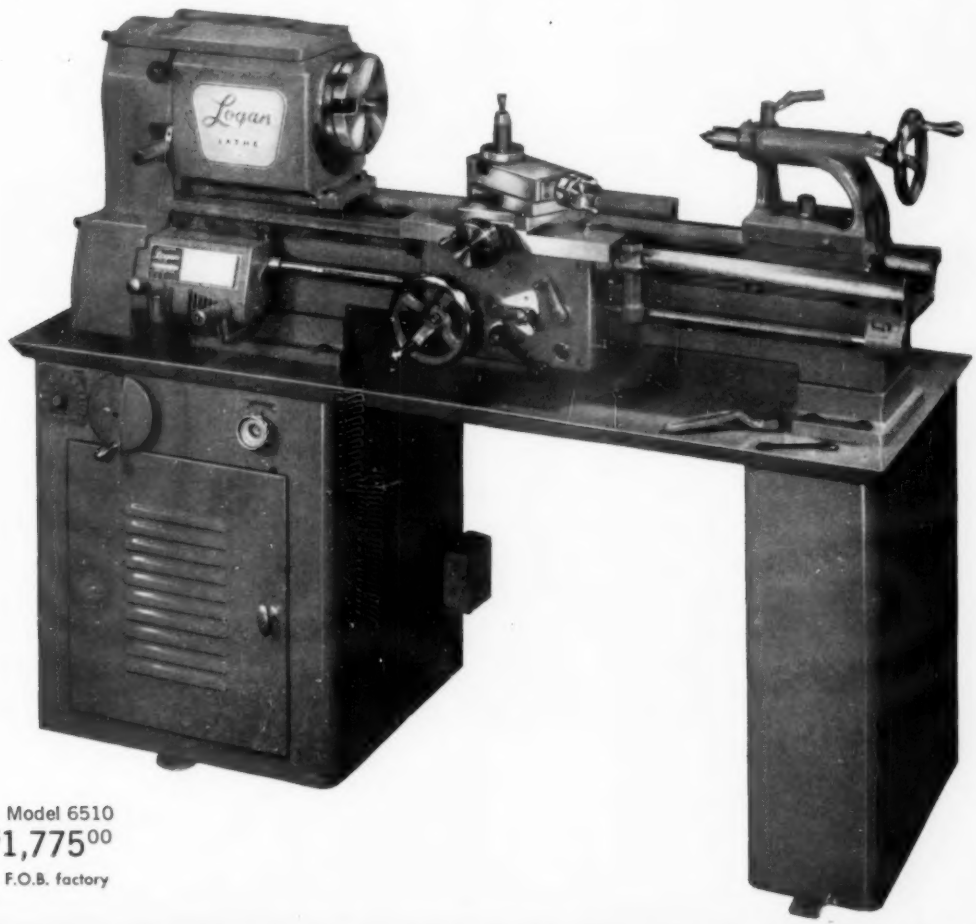
# dependable

**Logan / 14" LATHES**

How is a lathe's dependability measured? One criterion is the lathe's productive life-span. And this life-span is largely determined by the lathe's quality of design and construction. The Logan lathe bed is an example. It withstands the heaviest bending and torsional stresses. A special alloy and thorough seasoning (before and between machining) insure a warp-free bed. Also, the two V-ways and flat ways are precision ground. You can depend on Logan's low operating cost, too. The 14" swing lathes have variable speed drive (40 to 1400 RPM), and are instantly adjustable while work is turning—without shifting belts! You can also depend on the flexibility of Logan lathes. They have a 9" swing over saddle, 14 5/8" swing over bed, and a 1 1/16" collet capacity to permit a wide variety of operations. But, specifications tell the full story. So, write today for complete information.



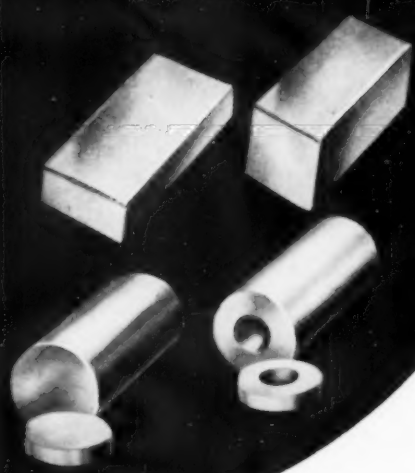

Model 6510
$1,775.00
F.O.B. factory

**Logan**

**LOGAN ENGINEERING CO., DEPT. U-561**
**4901 W. Lawrence Ave., Chicago 30, Ill.**

# MILNE

## For Years A Specialist IN TOOL STEELS



As America's leading tool steel specialist, MILNE is well equipped to service your tool steel needs. Whatever your requirements may be, Milne will help you get full advantage from today's progress in tool steel technology.

Every Milne sales representative is a qualified expert who can call upon the concentrated knowledge and ability of the entire nationwide Milne organization to give you the *right* steel, in the *right* place at the *right* time.

**LARGE ENOUGH TO SERVE YOU —SMALL ENOUGH TO WANT TO**

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America's Leading Tool Steel Specialists
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# Important Cost Reductions

## *In 2nd operation machining such as:*

- SPOT FACING
- DEBURRING
- CHAMFERING
- CENTERING
- TAPPING
- ECCENTRIC TURNING
- MILLING
- SLOTTING
- COUNTERBORING
- BOX TOOLING
- THREADING
- HOLLOW MILLING

## Standard MSO

**Eliminates these individual machines**

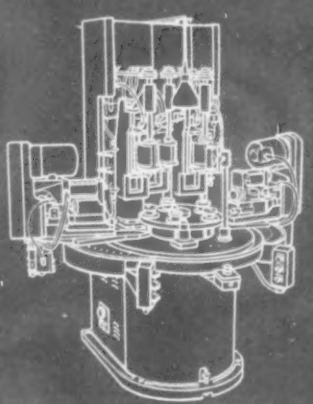
- Hand Screw Machines
- Drill Presses
- Light Milling Machines
- Tapping & Threading Machines
- Single Purpose Machines

**SIMULTANEOUSLY performs multiple operations** on a variety of pieces with extreme accuracy at continuous high speed production — for either long or short runs.

Superb engineering — flexibility of operation — quick, easy set-ups — and automatic functioning give you the finest in multiple 2nd operation machining. Complete specifications on Standard MSO, together with Case History Data are shown in new, illustrated folder.

Ask for Folder 61-M on your letterhead.

*Better Products at Lower Cost Through Better Methods*



Machine Open

MACHINERY DIVISION

## Standard Tool & Manufacturing Co.

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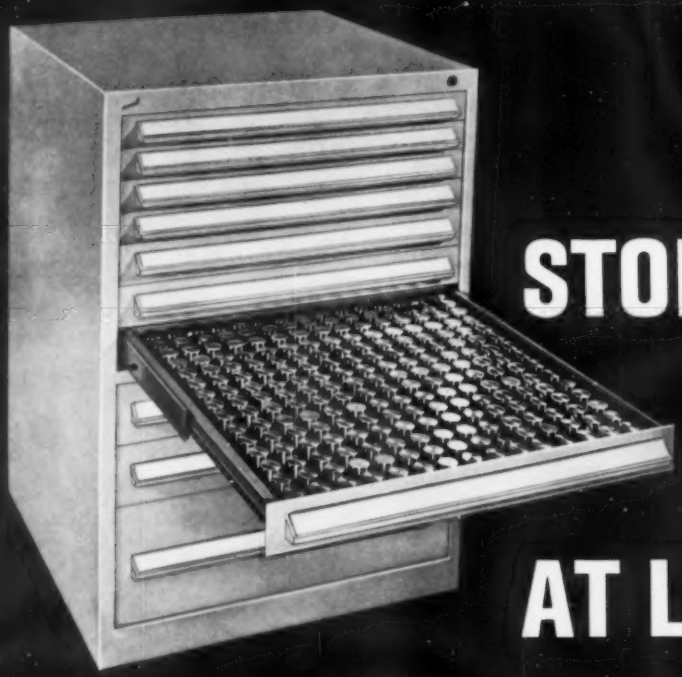
**See Standard MSO in operation at ASTME Convention . . . Booth 1341**



# STORE MORE, BETTER, AT LESS COST

THIS CABINET HOLDS THE ANSWER to efficient, time-saving, cost-cutting storage of parts, tools, instruments, accessories and subassemblies . . . because . . .

SPACE IS USED TO THE MAXIMUM. Drawers can be divided into unlimited arrangements, as small as 1½" x 1½"—or larger, right up to the full 25" x 25" drawer size. And if your requirements permit . . .

A VIDMAR INSTALLATION LIKE THIS will store more, better, in less space than any other storage system available. Vidmar cabinets are designed and built expressly for industry . . . eliminate "waiting time", dirt, breakage and pilferage.

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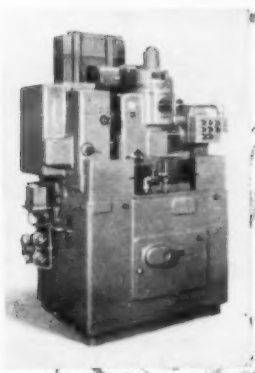
Before you revise or add to your storage facilities, or plan the storage in new construction, it will pay you to look into the time- and money-saving advantages of Vidmar. Write today: Vidmar, Inc. 2328 Reach Rd., Williamsport, Pa.

**Vidmar CABINETS** Division of Volkert Stampings, Inc.

Large and small corporations from coast to coast have installed Vidmar. See why! Booth 2545...

**ASTME SHOW**



*designed with a*
**GEAR-SHAPER**
*in mind!*

It's *practical* and *economical* to produce odd-shaped parts on a Fellows Gear Shaper.

Merely by using special cutters and fixtures on *standard* Fellows machines, an almost limitless variety of internal and external contours can be generated. In many cases, a single set-up does what ordinarily would require several conventional shop operations.

And, of course, *standard* Fellows generating equipment also provides high production of internal and external spur and helical gears, from "miniatures" up to 120 inches OD.

This versatile production method is fully described and illustrated in "The Art of Generating with a Reciprocating Tool." Send for your free copy of this informative booklet.

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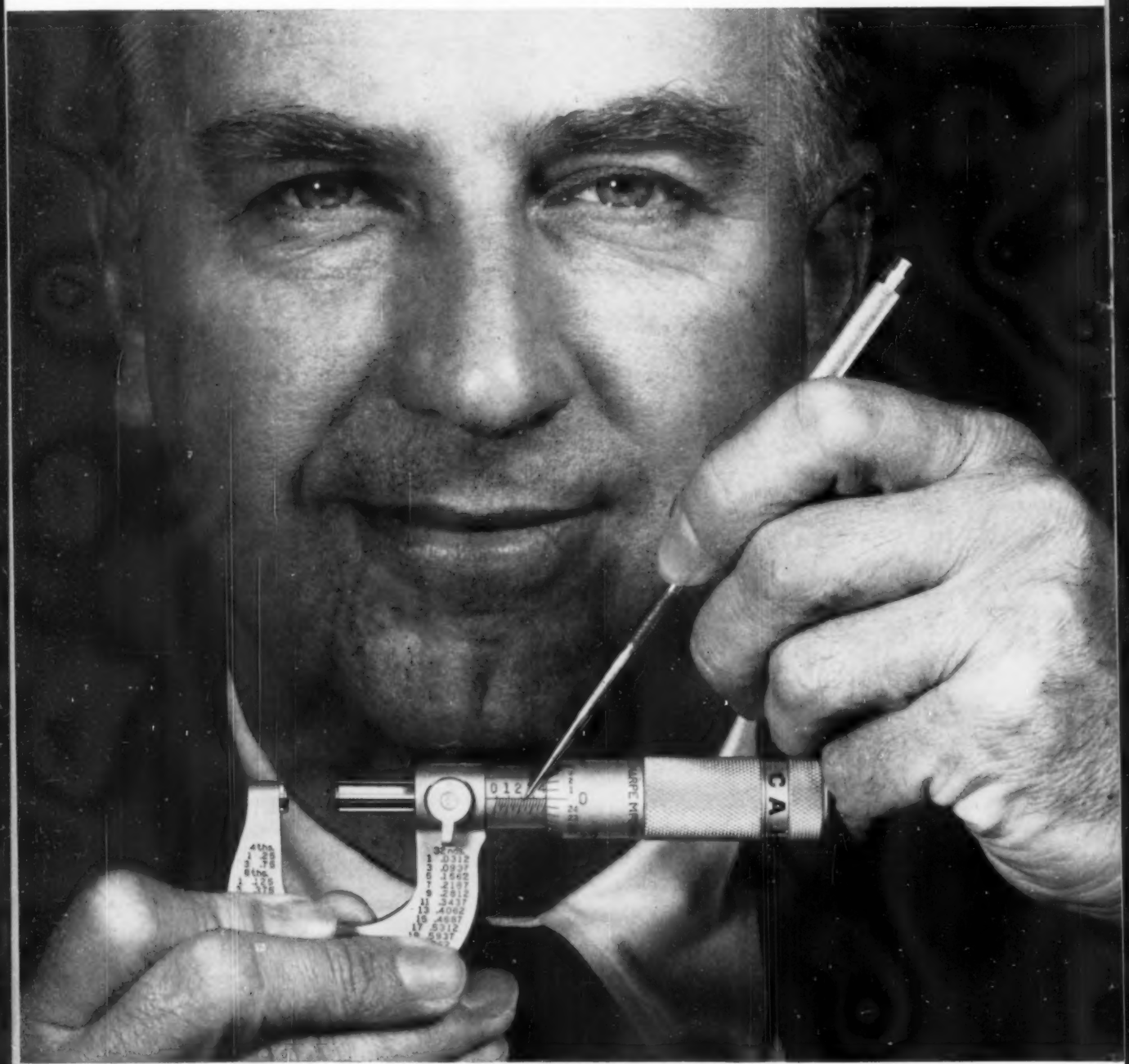
**THE PRECISION LINE**

*Fellows* *Gear Production Equipment*

A "live" demonstration from Brown & Sharpe...

# "Let me show you how Brown puts a stop to .025" errors –

... Mr. Thomas C. Roberts, Manufacturing Manager,



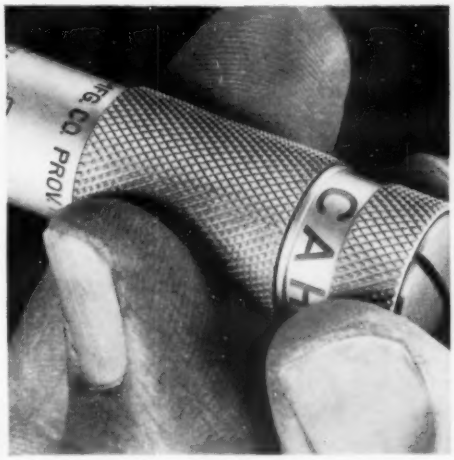
**"Look, the barrel graduations are *SLANTED* on this new B&S No. 1011 Micrometer." (0-1" by .0001.")**

"They can't suddenly hide under the end of the thimble, the way right-angle graduations on other mikes do — can't trick you into reading the wrong .025" line. They make it clear where you're going and where you've been. Even when you're tired or working in bad light, you read the slant-line right.

# & Sharpe's new '*slant*-line' mike boosts accuracy in your shop!"

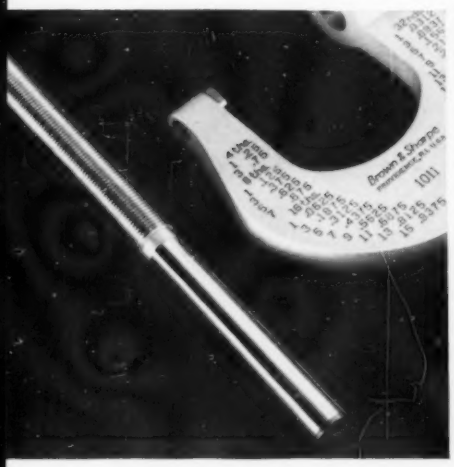
Brown & Sharpe, Industrial Products Division

**"I don't need to tell you** how much trouble the old '25-thousandth error' has caused over the years. But the slanted graduations on our new Brown & Sharpe mikes put an end to it, once and for all!

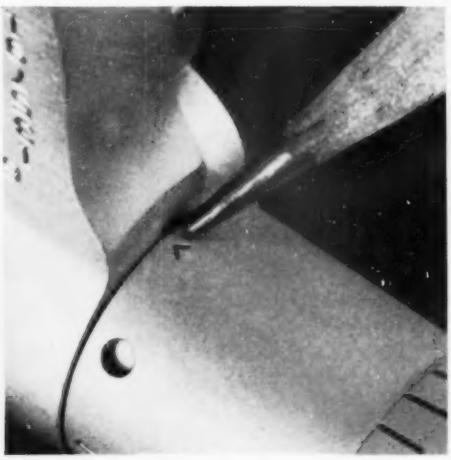


**"Do you like a solid-type thimble, or a 'friction' type?** A twist of a knob converts the entire thimble to the type of action you prefer Operation is identical, using the same sleeve, in either case.

**"It's a real one-hander!** You can work the lever clamp, thimble and friction sleeve with one hand, even when the mike's turned out. And, notice the personal initials. — furnished at no extra charge.



**"You get the corrosion resistance of a stainless steel spindle** in all Brown & Sharpe micrometers with carbide faces. Faces lapped to .000030". Micrometer accuracy is guaranteed with .0001".



**"Notice this Craftsman's Personal Mark.** Every B&S micrometer is 'signed' twice — once by Brown & Sharpe — once by the man who assembled it to give you an extra guarantee of highest quality.

**"Slant-line graduations** are now available on several other models of B&S mikes, in addition to No. 1011. Check with your local industrial distributor." Brown & Sharpe Mfg. Co., Providence 1, R. I.

**Brown & Sharpe** PRECISION CENTER

**SEE B&S MICROMETERS AT THE 1961 ASTME EXPOSITION — BOOTH 1315**

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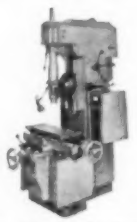
# MOORE ANNOUNCES UNPRECEDENTED 10-YEAR GUARANTEE OF MILLIONTHS' ACCURACY

**Published Tolerances**

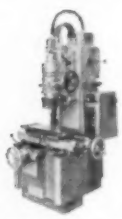
Longitudinal Travel:
Greatest error in any inch ..... 30 millionths
Greatest error in 18 inches ..... 90 millionths

Cross Travel:
Greatest error in any inch ..... 30 millionths
Greatest error in 11 inches ..... 90 millionths

Squareness:
Compound slide ..... 60 millionths
Full travel, spindle housing ..... 90 millionths
Full travel, spindle ..... 90 millionths



No. 3 Moore Jig Borer



No. 3 Moore Jig Grinder

**10-year Deviation Guarantee**

Lead Screws ..... 50 millionths
Quill fit, or clearance (Jig Borer) ..... 20 millionths
Vertical slide fit, or clearance (Jig Grinder) ..... 50 millionths
Compound slide squareness ..... 20 millionths
Base ways ..... 30 millionths
Table ways ..... 30 millionths
Squareness of spindle to plane of travel ..... 50 millionths

Moore can now, with confidence, guarantee the *accuracy-plus-durability* of hardened, ground and lapped lead screws and ways, plus the other locating features of its No. 3 Jig Borers and No. 3 Jig Grinders. Here's why:

The first No. 3 Moore Jig Borer built has now been operating in our toolroom for 5 years, an average of 2,300 hours per year. We have also inspected several other No. 3 machines in customers' plants. Our experience with hardened, ground and lapped lead screws now goes back 30 years. All of this history has provided us with sufficient data to project the performance of our No. 3 machines over a 10-year period.

As a result, we will now *guarantee* that the basic locating features of the standard No. 3 Moore Jig Borer and No. 3 Moore Jig Grinder will not wear or deviate in normal use *beyond published tolerances* over a 10-year period more than the specified amounts shown above.

This guarantee is retroactive to include the No. 3 Moore Jig Borers and Jig Grinders already built and in use. It applies to original owners only, and is in addition to our unqualified 1-year guarantee.

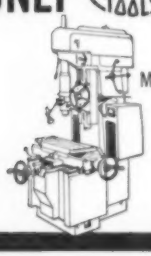
You can call in our service man to check your machine at any time, at our regular charge. If this check reveals wear in excess of that specified above, we will correct the machine promptly at our expense.

Dick Moore

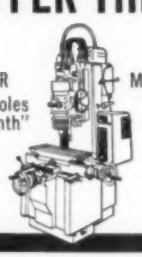
Richard F. Moore, President
Moore Special Tool Co., Inc.,
732 Union Avenue,
Bridgeport 7, Conn.
April 1, 1961

**While in New York call Forest 6-3226 (Bridgeport) for visit to our plant**

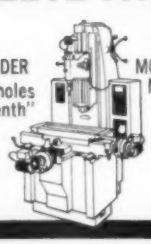
## ONLY MOORE TOOLS CAN OFFER THIS COMPLETE PACKAGE OF PRECISION



MOORE No. 3 JIG BORER
Locates and bores holes to less than a "tenth"



MOORE No. 3 JIG GRINDER
Locates and grinds holes to less than a "tenth"



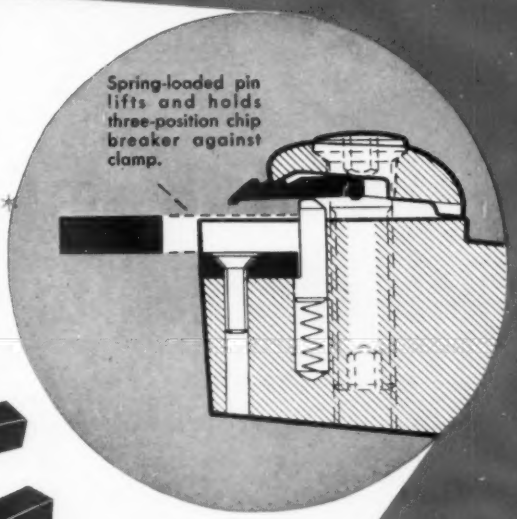
MOORE UNIVERSAL MEASURING MACHINE
Measures to one-third of a "tenth"

MOORE ROTARY TABLE
Divides the circle to less than 2 sec.

# FASTEST FAMILY of *FUMBLE-FREE* Toolholders!

## SANDVIK *Coromant*

# T-MAX



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A wide range of styles and sizes in Positive and Negative Rake holders to handle almost any machining job.

Exclusive; "Autolift" triple-purpose, low cost, solid carbide chip breaker.

Shim held by exclusive tempered spring pin. No screw to "freeze" or bind.

T-Max lets you change carbide cutting edge and chip breaker width without removing or replacing chip breaker.

Send for free Coromant catalog or contact your nearest Coromant office or distributor today.

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OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

## One of these CrysCoat® processes is job-matched to your pre-paint needs

ALL Oakite CrysCoat phosphating processes lock paint on . . . lock corrosion out, with a tight, dense integral coating on steel. But there's one that's *job-matched* to your present requirements . . . to give you the results you want for the lowest unit cost.

**Oakite CRYSCOAT 47: heavy, fast-coating iron phosphate.** Iron phosphating at its best. Cleans off average fabricating oils and soils as it phosphates; produces a premium quality coating, heavier and faster than ordinarily obtainable. Increases corrosion resistance. Conserves spray washer time.

**Oakite CRYSCOAT 87: smooth, paint-saving iron phosphate.** Thin, dense, smooth iron phosphate coating for tank or spray set-up uses only 3 stages, since it cleans as it phosphates. Saves time, equipment, easy to control. Takes less paint for a smooth finish, and gives at least double the 250 hour specified minimum of salt spray resistance.

**Oakite CRYSCOAT 89: economical, iron phosphate.** Iron phosphate process works in spray washing machine without foaming. Easy to control, requires no stainless steel equipment. Provides both cleaning and phosphating action simultaneously.

**Oakite CRYSCOAT HC: heavy duty zinc phosphate.** For tank application. Creates a heavy zinc phosphate coating for severe service conditions. Meets and surpasses standard Government specifications. Exceeds the 150 milligram per square foot requirement; up to 1200 milligrams obtainable.

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**Oakite CRYSCOAT FG—smooth, dense zinc phosphate.** Develops a fine grain zinc phosphate coating. May be used in spray washer or tank immersion. Low to moderate temperature process. Promotes a smooth paint finish.

Products with a CrysCoated finish look better and last longer. Ask Oakite about these and other CrysCoat processes. Or ask for illustrated Bulletins that give full details. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

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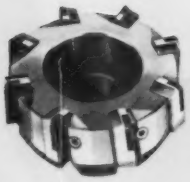

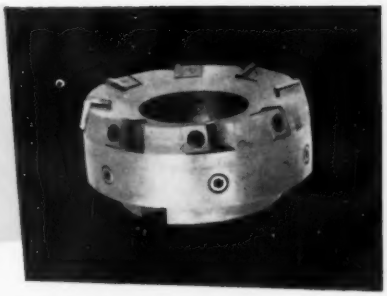

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# We make it!

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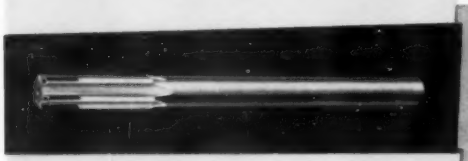

**Super**

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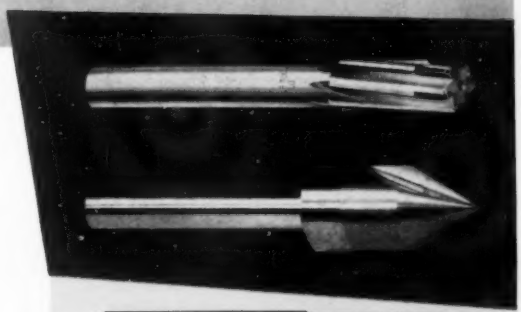

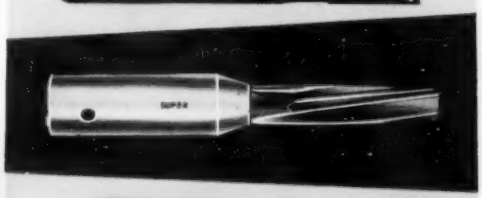

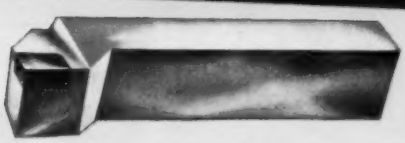

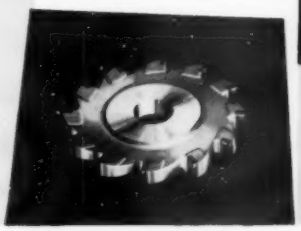

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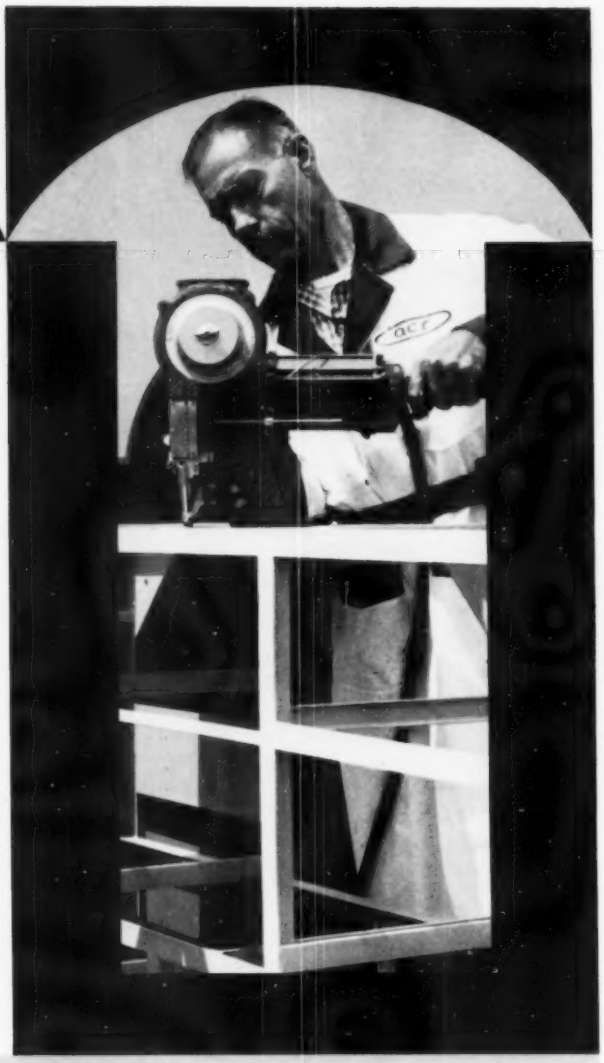

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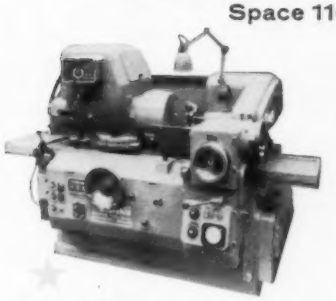

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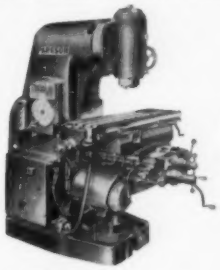

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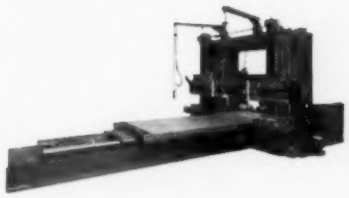

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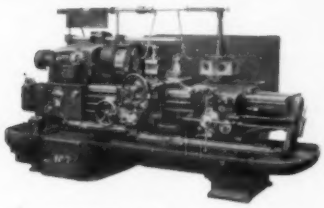

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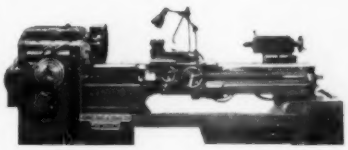

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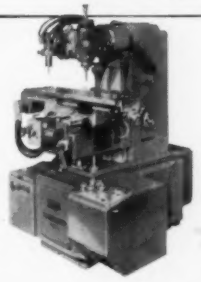

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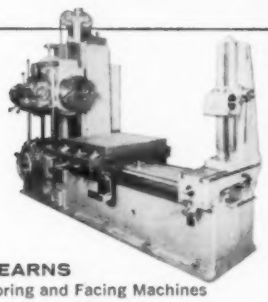

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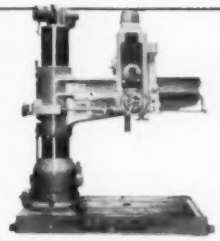

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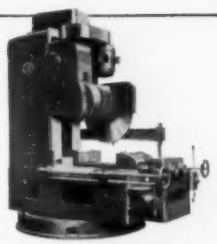

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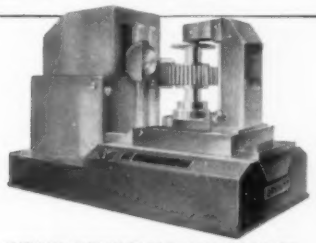

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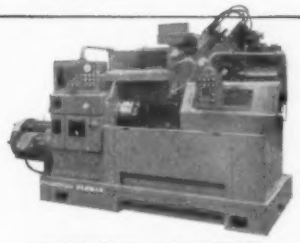

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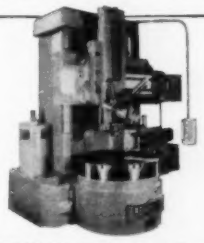

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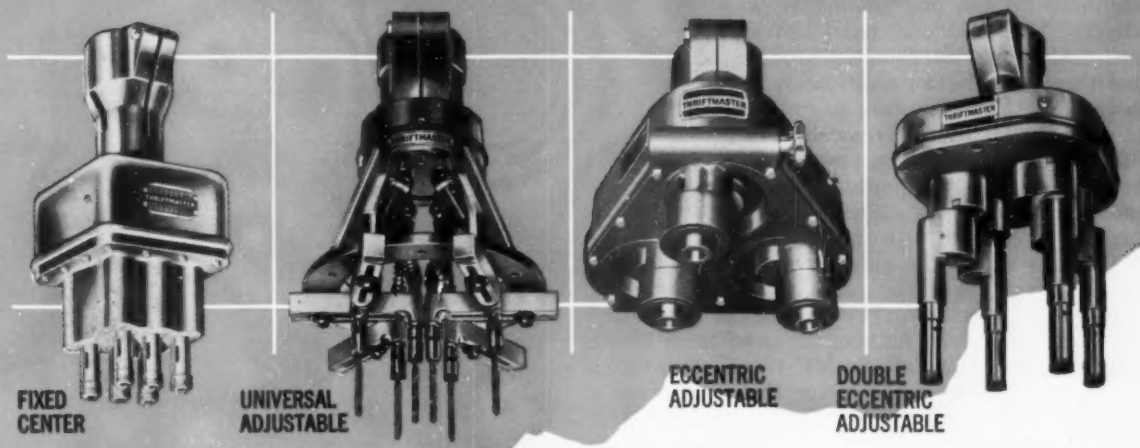


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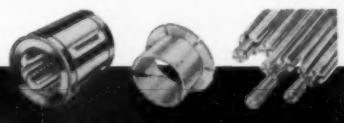

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## *Simplified method of checking for*

# GEAR ANGULAR ERROR

*RICHARD L. THOEN*
*General Mills, Inc., Minneapolis, Minn.*

Experience has shown that the great bulk of angular error patterns are relatively smooth. As a consequence, the maximum angular error can be established with about 10 readings. Thus, instead of a separate indexing instrument, angular error can be checked with a small optical polygon mounted directly on the gear mounting arbor (or gear shaft), Fig. 1, thus eliminating the bothersome measurement errors due to (a) runout of an indexing spindle, (b) the driver coupling between an indexing spindle and the gear mounting arbor (or gear shaft) and (c) skewness between an indexing spindle axis and the gear axis. It should be noted that the polygon mounting is not critical. A decentered polygon introduces no error, and the effect of wobble is usually insignificant.

### Gear roll tester used

A gear roll tester is ideally suited for checking angular error, Fig. 2. The measuring slide is set to the proper center distance (i.e., to the center distance at which the pawl contacts the work gear inside form radius) and locked. The polygon is mounted on the gear mounting arbor (or gear shaft). The gear and pawl are mounted in the roll tester, the micrometer brought to the mid-position and the autocollimator is zeroed on a polygon face. To measure angular error, the pawl is rotated out of mesh, remeshed so as to bring an adjacent face into view, and the angular error is read in the autocollimator. The friction in the mounting centers is sufficient to keep the driven profiles in contact with the pawl.

In cases where the number of work gear teeth is not a multiple of the number of polygon faces, a slight pawl rotation (never more than ½ tooth) is necessary. If the number of pawl teeth is not less than 40 (on a full circle), the pawl rotation will never exceed $\pm 4.5°$. Over this range, for a suitable arm length, it is usually permissible to use the approximation 0.001 inch/minute of arc in presetting the pawl.

If desired, peak readings can be checked for the possibility of higher peaks by comparing changes in micrometer settings against corresponding changes in autocollimator readings.

A side advantage of checking for angular error on a gear roll tester is that erratic readings can be checked for dirt and burrs by simply releasing the measuring slide lock and reading the tooth-to-tooth composite error.

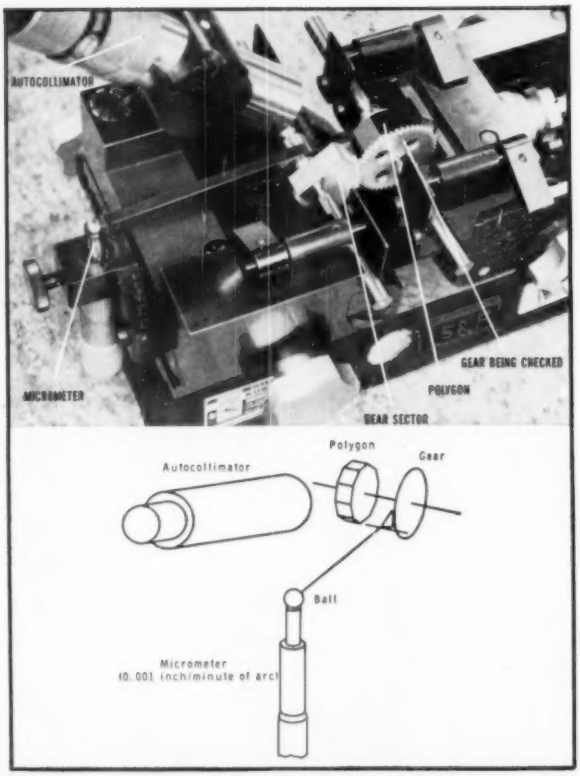


**FIG. 1.** A simplified method of checking for gear angular error.

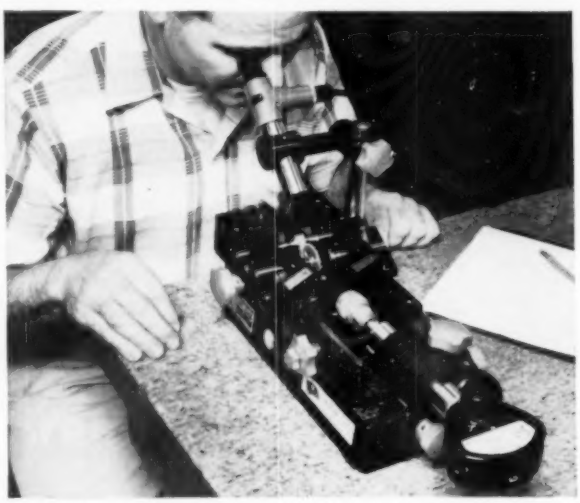

**FIG. 2.** An S & F gear roll tester set-up for checking angular error.

*The foregoing was extracted from a paper presented at the International Conference on Gears and Gear Drives held at Essen, West Germany, October 18 and 19, 1960. It is presented here as a service to the fine-pitch gear industry. Reprints are available on request to Gear Division, Kurt Orban Company, Inc., 44 Exchange Place, Jersey City 2, N. J.*

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See S & F Gear Testers in Booth 2011, ASTME Tool Show

# Tool Steel Topics

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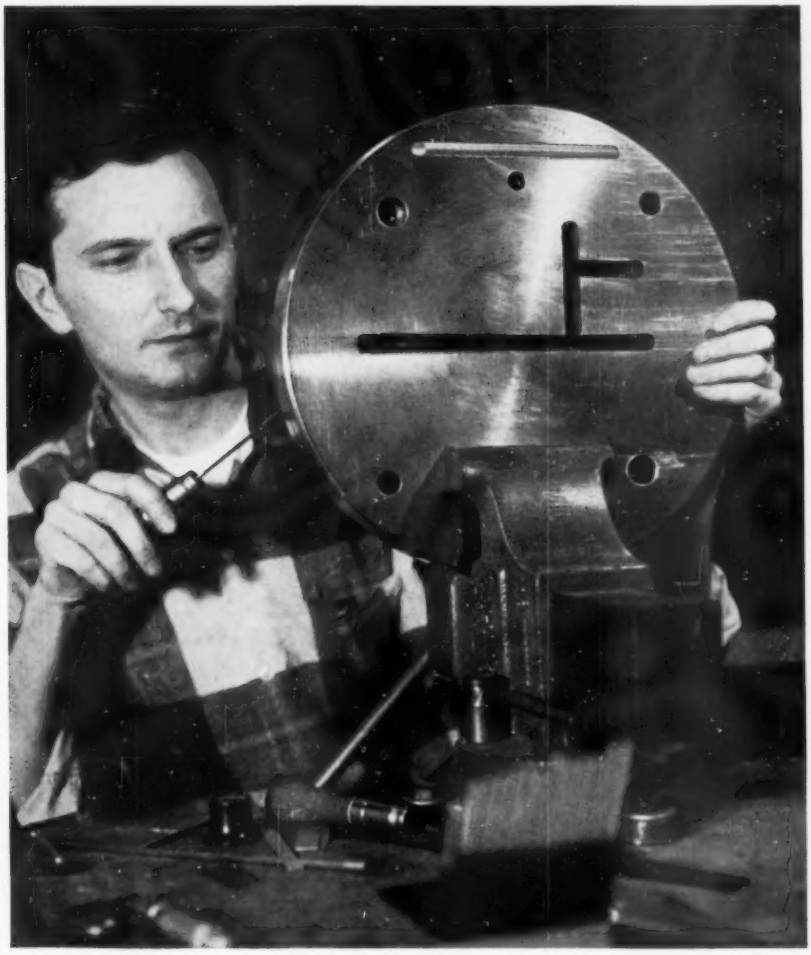

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## BETHLEHEM TOOL STEEL ENGINEER SAYS:

### *Here's the Way to Grind Tools*

After tools are hardened, it is customary to grind them to remove scale and decarburization, or to produce exact dimensions, or both. Basically, the aims are: removal of the desired amount of metal without damaging the hardened surfaces, and the most rapid development of the required surface finish.

It is usually recommended that hardened tools be ground with a vitrified aluminum oxide wheel of 24 to 80 grit. For example, a coarse grit, such as 24, should be used on Bethlehem Lehigh H . . . a high-carbon, high-chrome grade (D-2). The finer grits can be used on Cromo-WV hot-work grade (H-12). The use of soft wheels is suggested. Effective cooling should be done at the point of wheel contact, by using adequate cooling fluid. About .002 to .003 in. should be removed per pass for roughing cuts, and .0005 in. per pass (or less) for finishing cuts.

Hand-stone or fiber-wheel brush the tool edges after grinding, to remove burrs. In many shops, these operations have been replaced by a finish grinding pass with a 320-grit wheel. Properly applied, this pass leaves no burr.

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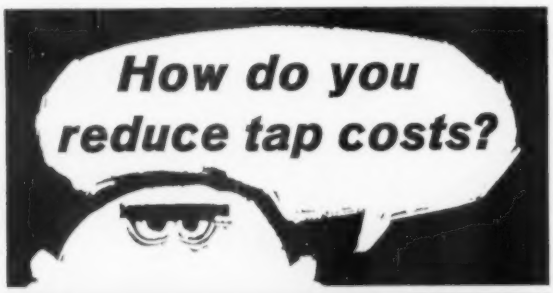


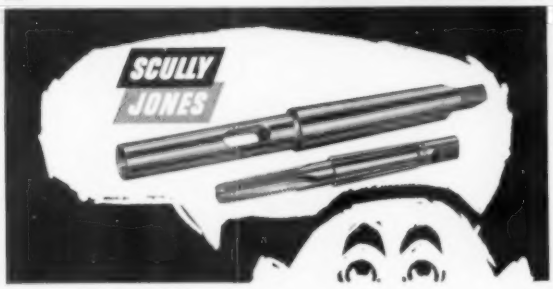


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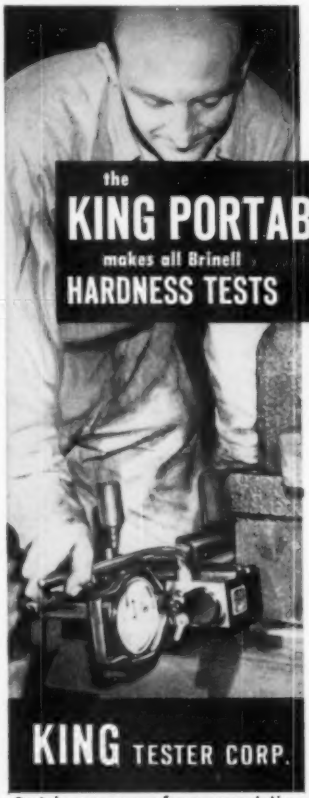

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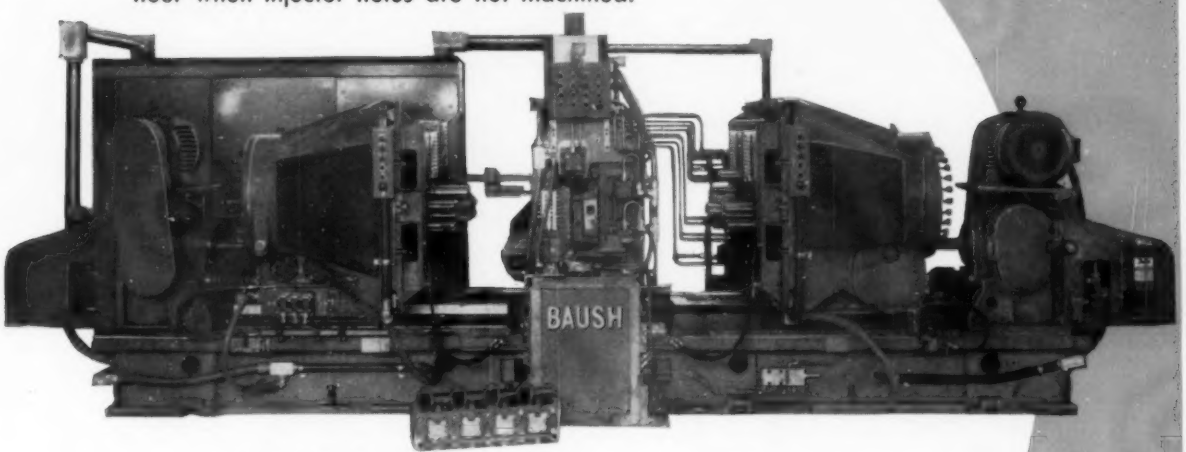
**is easy to recognize when you watch machines like this BAUSH 2-WAY HORIZONTAL "M-25" MECHANICAL SCREW FEED in operation, because - - -**

- **No hydraulic fluid is needed — a real savings**
- **No fluid leaks or feed fluctuations — reduces maintenance**
- **No "break-thru" surge — reduces work spoilage**
- **Positive, smooth ball-screw feed — saves breakage**
- **Part spoilage and tool breakage is reduced to minimum**
- **Your own mechanic can maintain units — reduces cost**

## PRODUCTION:

Designed specifically for drilling, counter-boring, reaming and forming valve seats, this machine finishes 12 cylinder heads an hour when machining injector holes, and 18 per hour when injector holes are not machined.




## SPECIFICATIONS:

This Baush machine is fully automatic — has two 27" x 50" drilling heads with a total of 76 spindles with each spindle arranged for two speeds and a neutral position. The master-bored cluster plates have slip-sleeve spindles and entire unit has Trabon lubrication throughout.

Fixtures are transfer bar type; fully automatic to accommodate three different size cylinder heads. Base is arranged for chip conveyor disposal and the 5 motors and electrical controls are J.I.C.

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**MACHINE TOOL CO.**
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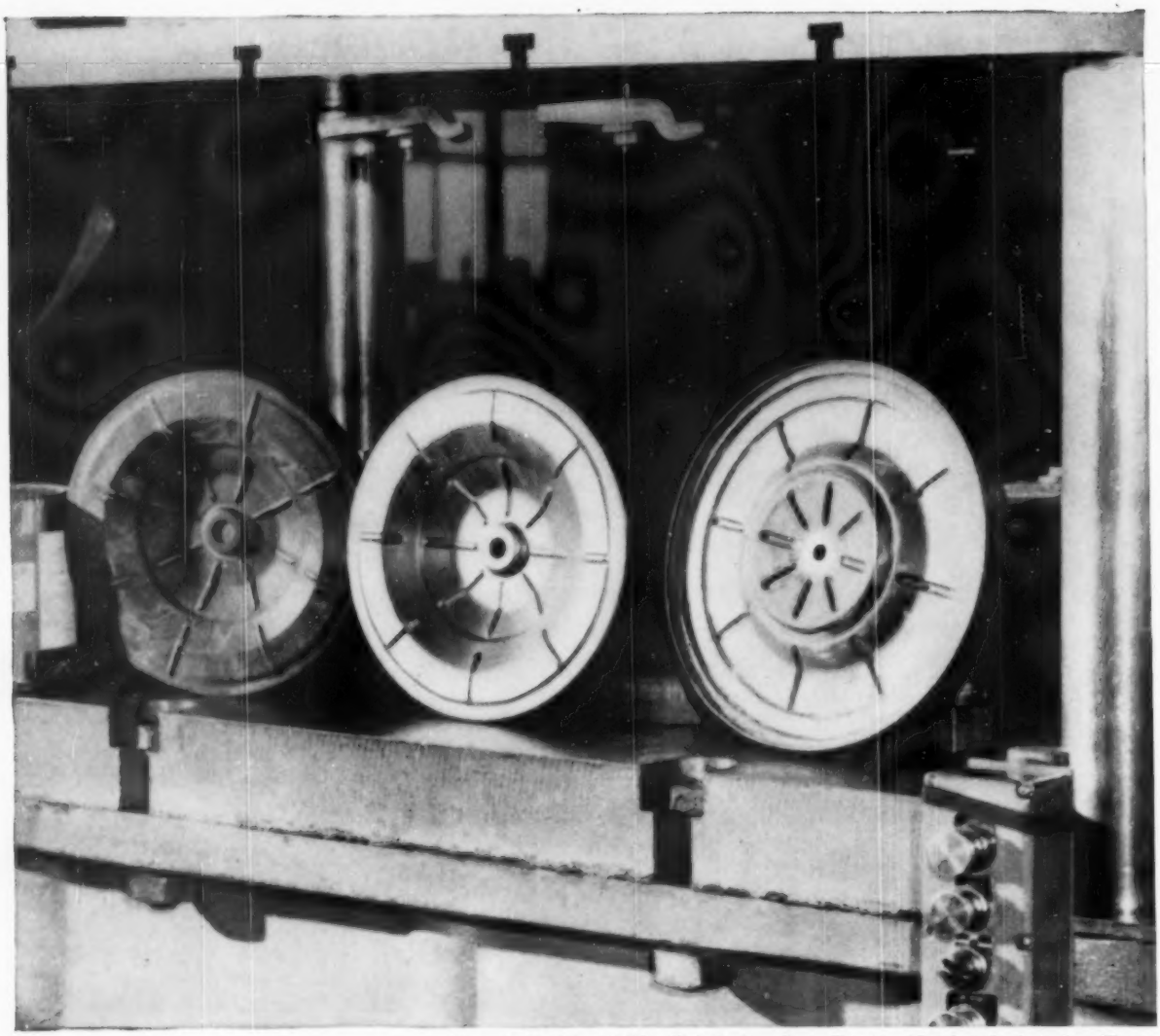

Dies made by Industrial Wire Cloth Products Corp., Division of Purolator Products, Inc., Wayne, Mich., using "Plastic Steel" tooling compounds formulated by Devcon Corporation, Danvers, Mass.

# Made in two days, at 60% less cost, "Plastic Steel" dies stamp cold-rolled steel

The picture above shows a carburetor air cleaner cover formed from cold-rolled steel by the male and female dies flanking it. Ten thousand of these pieces can be stamped out before the dies, made from Devcon tooling compounds based on BAKELITE Brand epoxy resins, have to be replaced.

But new dies can be made in two or three days instead of three or four weeks needed with metal. They are simply cast around a model. If alterations are required in existing dies, they can be made by grinding or patching, in a few hours, instead of welding, soldering, or machining. All together, the advantages of Devcon epoxy dies have brought the manufacturer a reduction of 60% in die costs alone.

In addition to metal-forming dies, you can use epoxy tooling for jigs, checking fixtures, templates, and other tools. They are tough, lightweight, dimensionally stable, and accurate, with shrinkage at a minimum.

Tooling compounds based on BAKELITE Brand epoxy resins may hold some extremely important economies for you, and deserve a thorough investigation. Contact or write your epoxy tooling resin formulator, or Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

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...with NON-ROTATING SPINDLE

HERE IS A SUPER PRECISION MEASURING MACHINE, 0-1" READING IN 50 MILLIONTHS or 20 MILLIONTHS

only **$192.50**
Reading in .000050"

For measuring and inspection of small parts, choose from ELEVEN DIFFERENT INTERCHANGEABLE ANVILS, ASSURING A SET-UP FOR EVERY APPLICATION

For production inspection, the comparator head is available with special electric-limit contacts activating signal lights. Contact Accuracy: .000010"

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- Adjustable measuring pressure
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AT YOUR FAVORITE SUPPLY HOUSE OR WRITE TO
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## MARVECO LIVE CENTERS

Guaranteed to outperform and outlast any other LIVE CENTER.

The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.

**MARVEL TOOL & MACHINE CO.**
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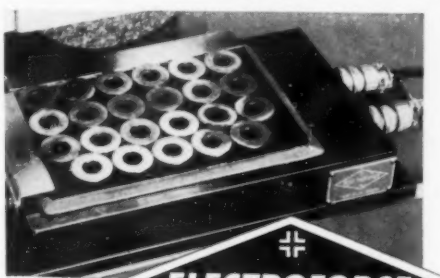
## SOLVE "IMPOSSIBLE" workholding problems




*Save Time and Money with*

## ELECTROSTATIC CHUCKING

Holds NON-ferrous, thin magnetic, exotic metals, *ALL* electrically conductive materials for PRECISION SURFACE FINISHING. Adaptable to many special holding problems. A PROVEN money-saver for electronic, aircraft, precision instrument industries, and toolrooms.

*Available for surface grinders in 5" x 8" up to 12" x 36" sizes. Also 6" and 12" rotary models.*

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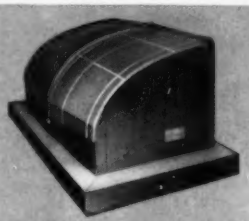
## EPOXY PLASTICS
### for tooling, pattern making and fixtures

REN epoxy plastic materials for tooling, fixtures, master model and pattern making can save up to 50% in man-hours and material costs. REN products offer constant batch-to-batch uniformity and high quality . . . in a wide range of formulations to fit application requirements exactly.

**REN-Wood model faced with REN-Shape,** showing type of construction. (Built by Aero-Detroit Inc., Detroit, Mich.)



**REN-Wood**
A highly uniform, dimensionally stable, completely carvable plastic material for master model and pattern making. Savings result from 100% usability and defect-free composition.

**REN-Shape**
A fast-curing, carvable epoxy paste material featuring easy workability and dimensional stability. It provides a fast, accurate method of building and duplicating male and female parts, or as a repair or rebuilding material.

At no obligation, send today for your subscription to REN's bi-monthly publication, Tech-Ni-Tips/Tooling Digest.

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lansing 9, michigan

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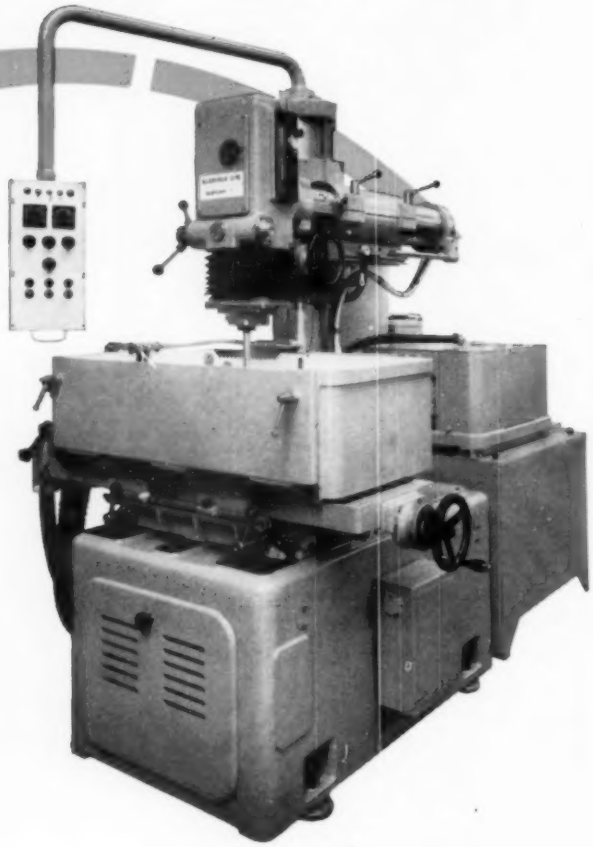
# ELERODA D1 & D15

## ELECTRICAL DISCHARGE MACHINES

### D-15

High Speed: 15 cu. inches per hour.
Unique Versatility: Machines are tailored to fit user's applications.
Hydraulic Servo: Electric Impulse Generator (EPL-500)



### D-1

An outstanding high precision erosion machine to work and locate with ± .0002". Surface Finish Guarantee 10 micro inches.

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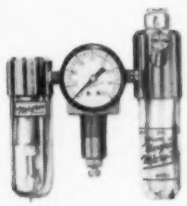
# Norgren Lubro-Control Units

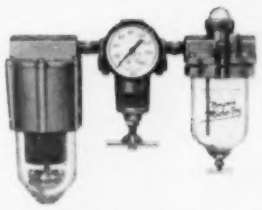
*A complete line of **visible oil feed** lubricator units for air-tools, air cylinders and other air-powered equipment*

## NORGREN Micro-Fog Combination Units

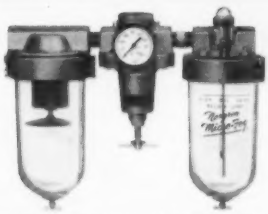
Easily adjustable for the exact amount of lubrication required



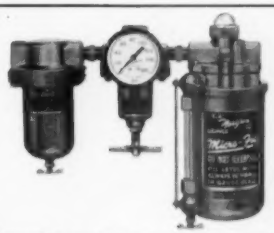
Transparent bowl filter; pressure regulator with gauge; transparent bowl Micro-Fog Lubricator. ⅛" pipe size. ½ oz. lubricator capacity. Small, compact unit for use where space is tight.



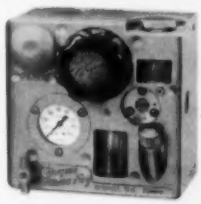
Transparent bowl automatic-drain filter; regulator with gauge; transparent bowl, Micro-Fog Lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. ½ pt. lubricator capacity.



Transparent bowl manual-drain filter; pressure regulator with gauge; transparent bowl, Micro-Fog Lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. 2½ pts. lubricator capacity.



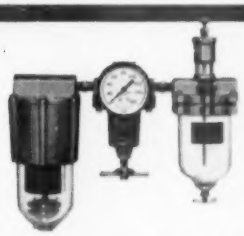
Replaceable metal bowl manual-drain filter; pressure regulator with gauge; replaceable metal bowl, Micro-Fog Lubricator with constant oil level. ¼", ⅜", ½", ¾", 1" pipe sizes. 1 qt. lubricator capacity.



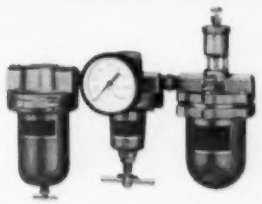
Compact cabinet unit for air operated machine tool applications. Provides filtered air, accurate regulation and control of oil delivery, visible, adjustable oil feed. ⅛" pipe size. 10 oz. oil capacity.

## NORGREN Oil-Fog Combination Units

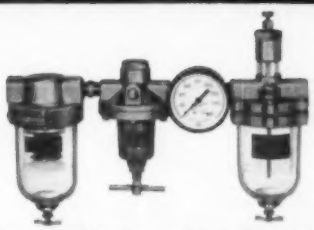
Efficient, effective lubrication of air-powered equipment.



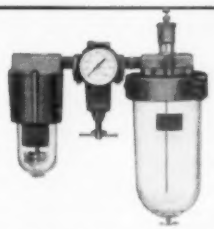
Transparent bowl automatic-drain filter; regulator with gauge; transparent bowl lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. ½ pt. lubricator capacity.



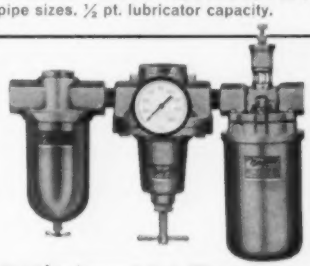
Replaceable metal bowl manual-drain filter; pressure regulator with gauge; replaceable metal bowl lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. ½ pt. lubricator capacity.



Transparent bowl manual-drain filter; pressure regulator with gauge on tee; transparent bowl lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. ½ pt. lubricator capacity.



Transparent bowl automatic-drain filter; pressure regulator with gauge; transparent bowl lubricator. ¼", ⅜", ½", ¾", 1" pipe sizes. 1½ qt. lubricator capacity.



Metal bowl manual-drain filter; pressure regulator with gauge; replaceable, metal bowl lubricator. ¾", 1" pipe sizes. 1 qt. lubricator capacity.

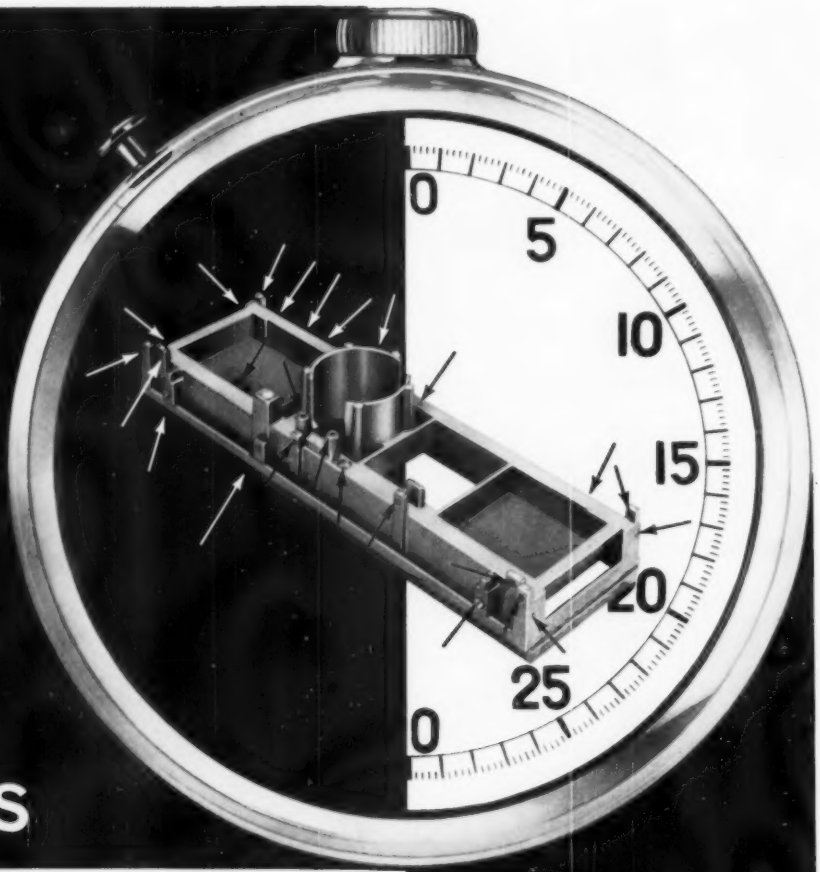
***Shown here are a few models from Norgren's complete line of air filters, pressure regulators and lubricator units. For full information, call your nearby Norgren representative listed in your phone directory, or write for descriptive literature.***

**C. A. NORGREN CO.**

3447 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

1612

# 25 HOLES 5 SIDES 30 SECONDS



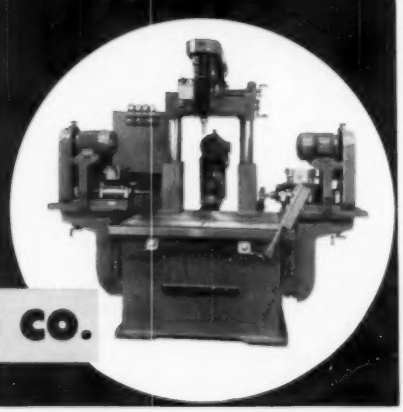

## ON THE WIS-MATIC 5-WAY MACHINE

In ONE work-cycle (30 seconds from floor to floor), holes are drilled, countersunk and spot faced to exacting tolerances on 5 sides of a 6-sided, highly irregular work-piece by this versatile, adaptable, 5-Way Drilling and Tapping Machine equipped with Package Tooling and Wisconsin Drill Heads. Here is what it does at the push of a button in this particular application:

- Top Unit drills 5 holes
- Left Unit drills 7 holes
- Back Unit drills 2 holes
- Front Unit drills 2 holes
- Right Unit drills 9 holes

*Write for illustrated Bulletin No. 560.*

**WIS-MATIC can solve your HOLE PROBLEMS just as efficiently, cut your hole processing time just as drastically.**



**WISCONSIN DRILL HEAD CO.**

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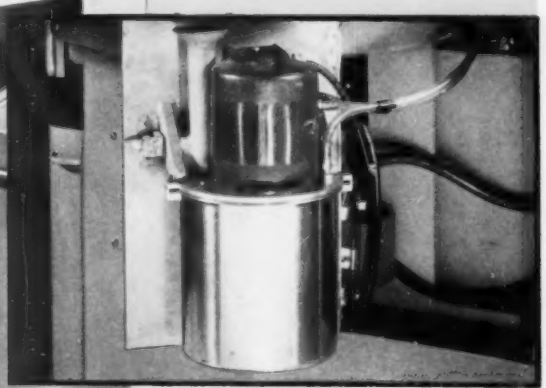
# New model 24 Lapmaster

**new compact machine design . . .**
more production lapping efficiency, yet takes less floor area . . . easy hand-wheel adjustment of conditioning rings to keep lap plate flat.

**new, larger, adjustable work table . . .**
wrap-around design for fast loading, unloading from almost any position . . . pneumatic lifts to facilitate work handling or to provide extra down pressure.

**new abrasive distribution system . . .**
pressure pump at constant head for uniform deposits at lapping stations . . . assures uniform cutting action to control the amount of stock removal . . . always maintains correct abrasive mixture . . . provides adjustable flow control.



Compound and vehicle distribution pump and tank swing out for filling ease, swing in, out of the way, during production.

Lapmaster®
. . . THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

Write for the Complete Lapmaster Story
*and chart on measuring flatness.*
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# INGERSOLL'S NEW BLADE BACK-UP SERVICE

**Provides individualized attention, adequate assured supply, maximum performance at minimum costs.** If your company uses milling cutters and blades, either the "Grind" or the "No-Grind" type, you should know about the first full-range approach, by any qualified source, to lower blade and cutter costs and to improve tooling performance. It provides service and attention superior to that available from any other blade source.

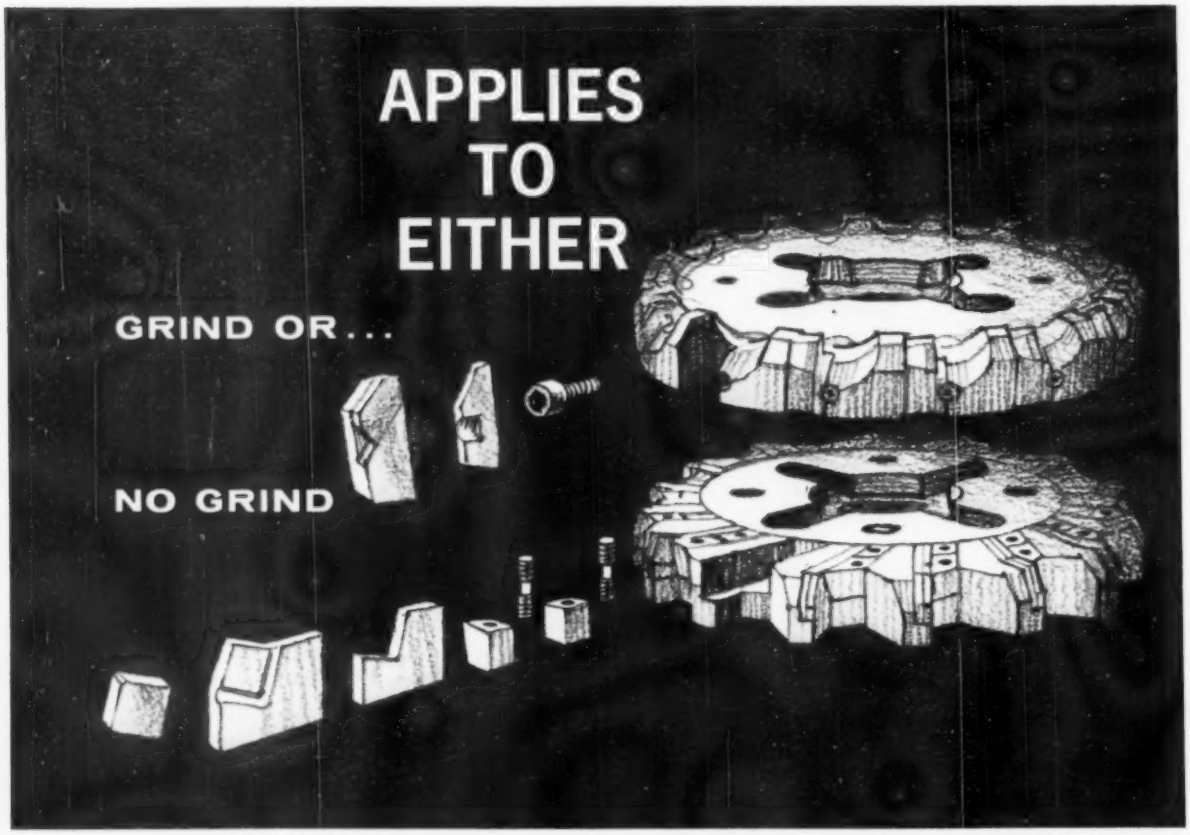
**What the Ingersoll Blade Back-up Service is.** The Ingersoll Blade Back-Up Service is an exclusive system designed to meet the objectives of the four groups of people concerned with cutting tool performance and costs: Purchasing, Tool Engineers, Shop Operating people, and Management.

- It assures the most economical blades to achieve the desired results
- It leads to better, lower-cost tool maintenance
- It permits reduced tool inventories, yet eliminates the danger of shortages and shutdowns
- It offers prompt emergency service when needed
- It gives you the benefit of research and development leading to new and improved cutting performance
- It assures the availability and fast delivery of the *right* blade, in the *right* place, at the *right* time

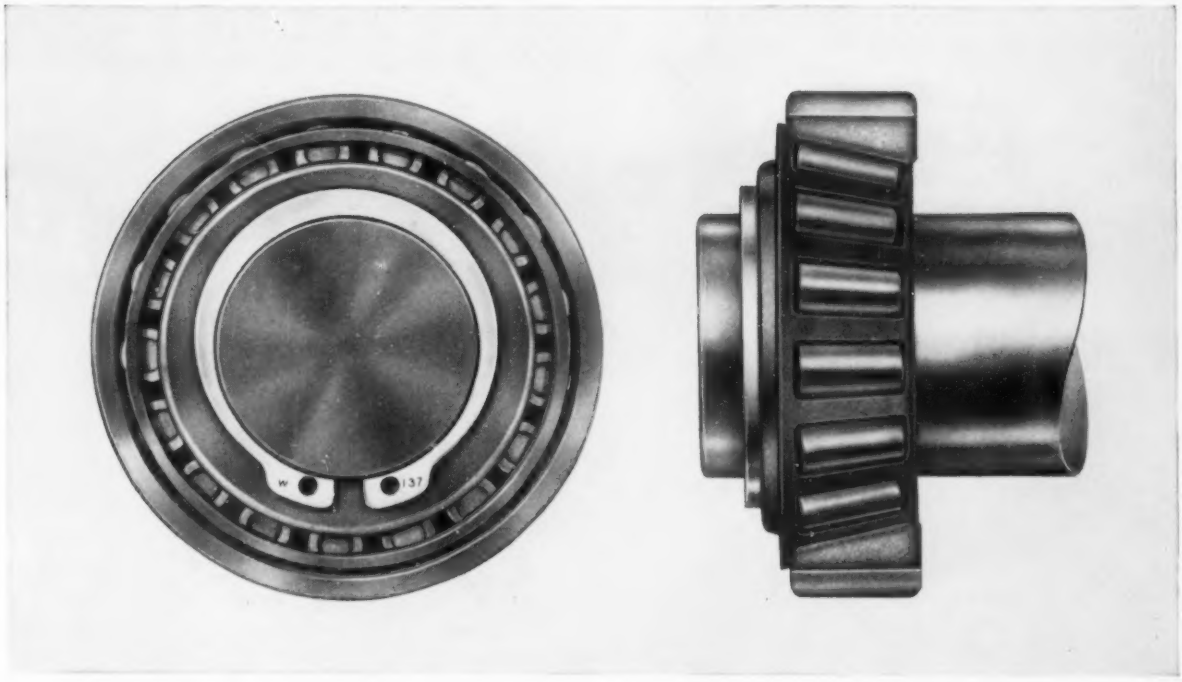
**How the Ingersoll Blade Back-up Service works.** Close cooperation between the customer and The Ingersoll Cutter Division can bring about spectacular results in cost reduction and in performance improvement. The Ingersoll Blade Back-Up Service permits reduced inventories in the plants of customers cooperating in this program backed up by stocks maintained by Ingersoll. The procedure includes a careful analysis of each operation, maintenance practices, inventory policies, performance requirements, and cost objectives. It includes the primary interests of operating, stores, purchasing and management personnel.

It often involves the development of new blades or cutters, the revision or elimination of grinding methods and equipment, and the modification of replacement stocks and reduction of inventory. Yet, it affords the advantages of quantity purchases of requirements preestablished by analysis of usage data.

No company offering cutters and blades is better equipped for full-range service and complete responsibility than Ingersoll. Ask to have an Ingersoll sales engineer give you complete information about Ingersoll's Blade Back-Up Service. Write: **The Ingersoll Milling Machine Company, Cutter Division, Rockford, Ill.**



# NEW! Waldes TRUARC Series 5160 Heavy-Duty Retaining Ring



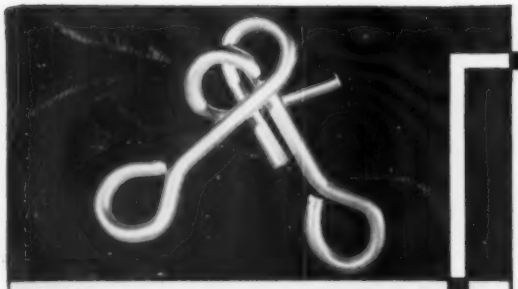
## for thrust and impact...for retaining bearings ...for a new approach to heavy-duty fastening

Now you can enjoy the benefits of a truly heavy-duty fastener — with all of the advantages and production economies retaining rings provide. The new Truarc Series 5160 is a unique external ring designed to secure components on shafts, axles and similar structural members. It has high thrust load and impact resistance and forms a shoulder sufficiently high to retain parts having large corner radii or chamfers. The Series 5160 is ideal for retaining bearings. You can use it *without spacer washers* to secure ball bearings, tapered roller bearings (shown above) and cylindrical roller bearings — all having large corner breakouts. The ring eliminates the need for machined shoulders, costly heavy-duty nuts and other bulkier and more expensive fastening devices normally required for extreme loading conditions. The Truarc Series 5160 is available in 11 popular sizes for shafts ranging from .473" to 2.0" dia. — and other sizes are on the way. You can order the Series 5160 in carbon spring steel or — for corrosion resistance and high temperature limits — in Armco PH 15-7 Mo stainless steel. Sizes up to 1.378" also are available in beryllium copper. For complete specifications, write for Truarc Data Bulletin No. 459-11. Better yet, contact your local Truarc Representative or Distributor. They're listed in the Classified Telephone Directory under "Retaining Rings" or "Rings, Retaining."

***SEE FOR YOURSELF*** — Send for a free sample of the Truarc Series 5160 Heavy-Duty ring. We'll include a standard external ring of the same size for comparison. You'll see the difference as soon as you open the envelope!

**WALDES KOHINOOR, INC.**

47-16 Austel Place, Long Island City 1, New York 61-1



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on your

## NEW MACHINE DESIGN

*We can solve it quick as you can say*

# STANDARD

**SUPER PRECISION**

# SPINDLES!

Combine them with slides, feeds or swivels and they'll do 'most any special milling, drilling, boring or grinding job you can come up with.

Pictured are just a few of the special "building block" units now being used in industry on jobs that used to be "puzzlers".

Standard's new catalog shows a gallery of combinations from the thousands we've helped Design Engineers put together. Send for your copy TODAY!

SEE OUR CATALOG IN SWEET'S MACHINE TOOL CATALOGS

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**the STANDARD electrical tool co.** SPINDLE DIVISION

Since 1912

**SUPER PRECISION SPINDLES AND MACHINE TOOLS**

**2499 RIVER RD. • CINCINNATI 4, OHIO**

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# CADDY

# AIR OPERATED
## TOGGLE CLAMPS

CADDY AIR OPERATED Toggle Clamps are recommended for jobs requiring fast loading and unloading. Clamps are available in 3 models with clamping pressures from 400 lbs. to 1000 lbs. Furnished with air restrictor fittings to insure smooth operation. Clamps have double action air cylinders. Black rust-proof finish.

Bolt retainer furnished with each clamp.

**FEATURES:**

1. HEAVY DUTY ALL WELDED CONSTRUCTION—Will withstand extreme abuse—will not spring or bend under maximum load.
2. EXTRA LARGE PIVOT PINS—In actual test under load clamps have withstood over half a million cycles without excessive wear.
3. SMOOTH ACTION—Cylinder restriction fittings give cushioned clamping action.

**CADDY® toggle clamp division**

***Erico Products, Inc.***

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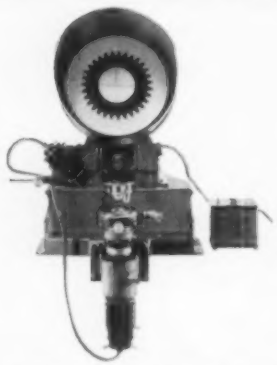
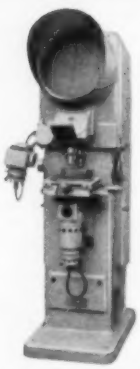
# NIKON

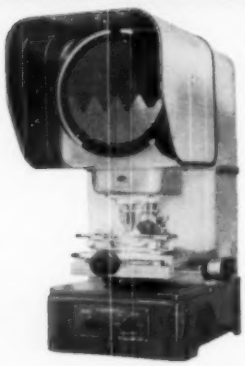
## PRECISION OPTICAL EQUIPMENT FOR EVERY INSPECTION NEED



OPTICAL COMPARATOR—BENCH MODEL 2



OPTICAL COMPARATOR—FLOOR MODEL 3



OPTICAL COMPARATOR—BENCH MODEL 6

AUTO-COLLIMATOR—MODEL 1

AUTO-COLLIMATOR—MODEL 3

STEREO MICROSCOPE—MODEL SM2

STEREO MICROSCOPE—MODEL SM

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**BOOTH 2150**
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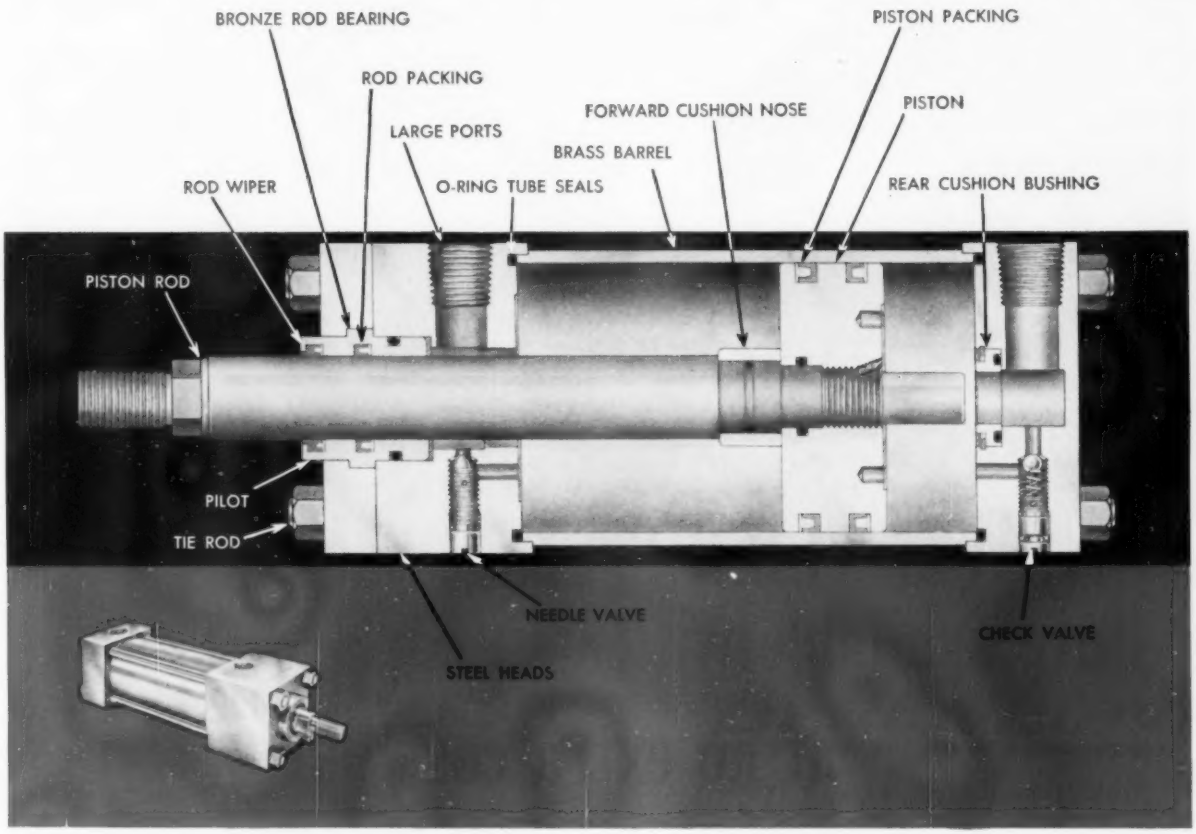
SIMPLE MEASURING MICROSCOPE

The above is only a partial listing of the many Nikon instruments designed to meet measurement and inspection requirements in production, quality control, intricate parts assembly, and other applications demanding fast, accurate inspection. For complete details, write to Dept. TE-5.

NIKON INCORPORATED
111 Fifth Avenue, New York 3, N. Y.

# NEW O-M AIR CYLINDER

## Series K•200 psi • 1½" to 14" Bores • Meets JIC Standards




## Built To Exacting O-M Spec's. Dimensionally Interchangeable

Ortman-Miller proudly presents, as an addition to its famous family of air and hydraulic cylinders, the all new Series K Square Head Air Cylinders. Every effort has been made to carry on the tradition of high quality that industry has learned to expect from Ortman-Miller. Such factors as experience, engineering, design, craftsmanship, and the highest quality components have been skillfully blended to assure the high standards of quality.

The O-M Series K cylinders have been designed for maximum operating efficiency, long life, and quick and easy maintenance.

For complete details write for Bulletin No. 115 in which all cylinders have been dimensioned in accordance with NFPA recommendations for your convenience.

**ORTMAN-MILLER MACHINE CO.**
13 143rd Street, Hammond, Indiana

☐ Have representative call.

☐ Send Bulletin 115

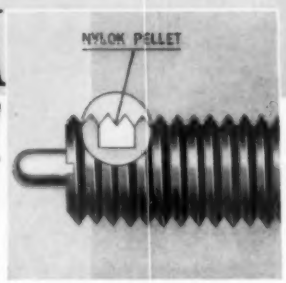
Name_____ Position_____

Company_____

Address_____

City_____ Zone_____ State_____

# NOW all VLIER Spring Plungers are available with NYLOK at no extra cost!




**Nylok-fitted bodies are self-locking; eliminate need for checknuts or other secondary locking devices.**

Whether you use Vlier Spring Plungers on tooling, or for original equipment applications, you'll like this new self-locking feature.

Each Vlier Spring Plunger body is permanently fitted with a tough, resilient nylon pellet which slightly protrudes above the major thread diameter. As the plunger is inserted in the tapped hole, this pellet is *compressed* (not cut), exerting a spring-like pressure on one side of the plunger body. This *constant* lateral thrust wedges the mating threads together, assuring a *positive* lock that remains vibration-proof regardless of cyclic loads.

**PERFECT FOR USE WHERE PERIODIC ADJUSTMENTS MUST BE MADE**—The self-locking feature is effective whether the body is seated or not, permitting the Vlier Spring Plunger to be easily and accurately adjusted as required... cannot back off or be shaken loose once set.

**RE-USEABLE MANY TIMES**—When the Vlier Spring Plunger is removed, the Nylok pellet strives to return to its original shape. Parts can be used numerous times before any locking pressure is lost.

**NO EXTRA COST FOR SELF-LOCKING FEATURE**—All standard Vlier Spring Plungers are now available with the self-locking feature at no increase in price! However, all models may still be ordered without Nylok.

*Your Vlier distributor now has Nylok-fitted Vlier Spring Plungers on his shelf. Order a supply today.*

VLIER
Engineering Corporation
A subsidiary of Barry Wright Corporation
8900 Santa Monica Blvd., Los Angeles 46, California

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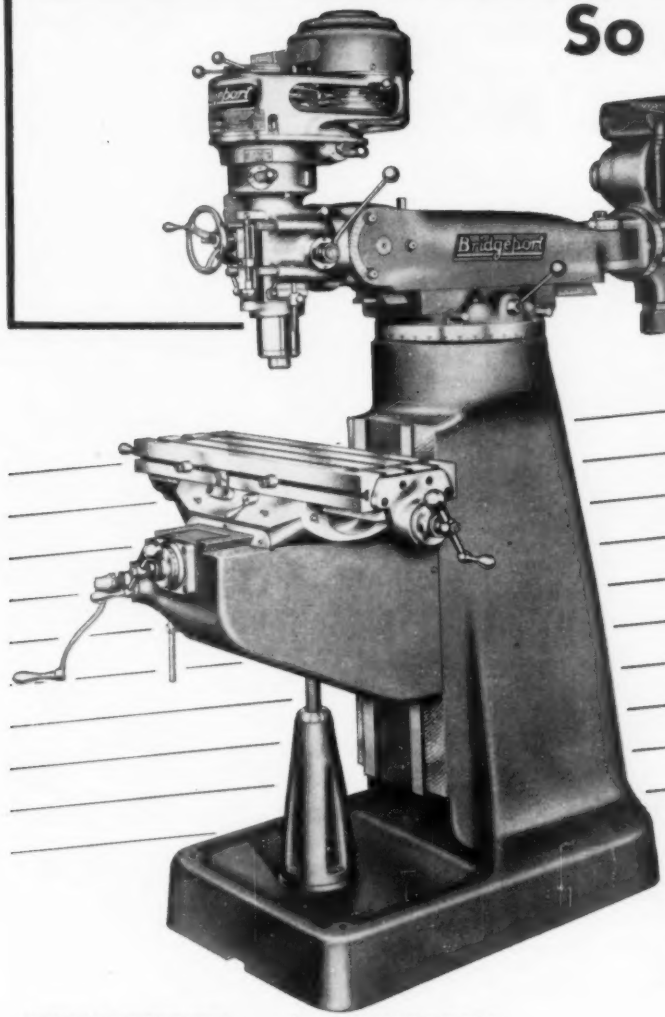


MILLING
DRILLING
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RIGHT ANGLE MILLING
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*"THE MOST FOR THE LEAST"*

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### to increase versatility

**Milling, Drilling and Boring Attachments; Model "J" 1 HP; Model "M" ½ HP; Model "R" ½ HP and Model "C" ¼ HP (Rigid Spindle)**

- Cherrying Attachment
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***Further details are available through your nearest dealer or from us direct.***

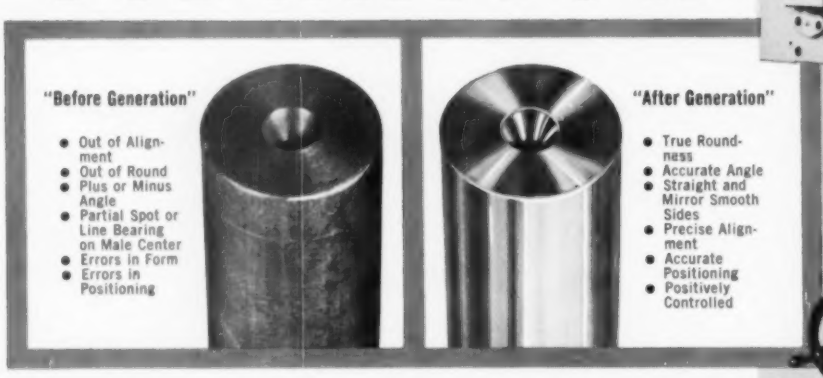
**Bridgeport® MACHINES, INC.**

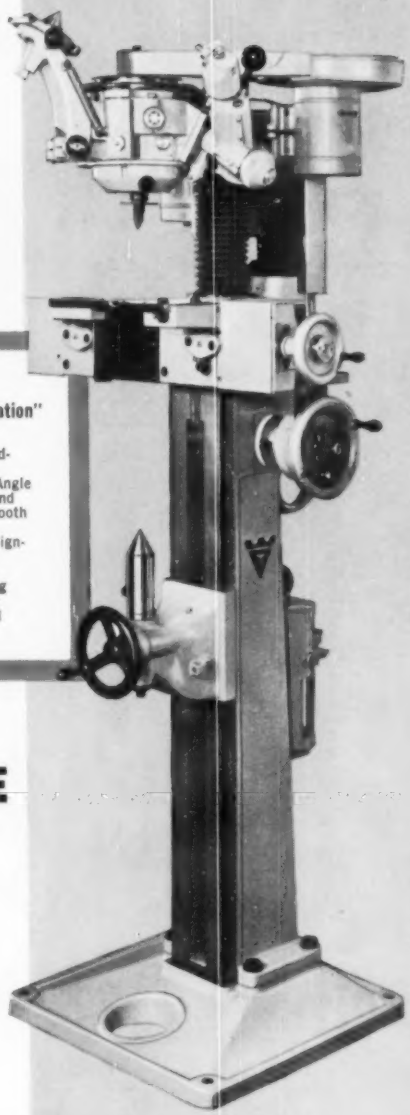
*Bridgeport, Connecticut*

*Manufacturers of High Speed Milling Attachments and Turret Milling Machines*

# A Revolution-A New System That Never Fails!

## NOW YOU CAN GET ROTATION WITHOUT VIBRATION



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***can produce for you with UNSKILLED labor:***

1. It generates a true geometric center in a standstill workpiece
2. It positions two opposite centers in precise alignment establishing a geometric axis
3. It plants a true geometric center right in the middle of standstill workpiece establishing concentricity
4. It shifts centers to correct and salvage parts that are eccentric
5. It double generates
6. **It establishes concentricity and roundness within millionths of an inch.**

***STOP LOSSES NOW. DIMINISH METAL REMOVAL—MAKE MORE PROFITS. GET THE FACTS ABOUT THE REVOLUTIONARY TECHNICA THAT PAYS FOR ITSELF QUICKLY.***

**Now profitably in use at:**

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## HIGH PRECISION PRODUCTS

WESTFIELD, NEW JERSEY

To: HIGH PRECISION PRODUCTS • Westfield, New Jersey

Gentlemen:
Please send more information about the revolutionary, new Technica Center Grinding Machine and the following brochures: 1 ☐ 2 ☐ 3 ☐

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CO. ADDRESS _____

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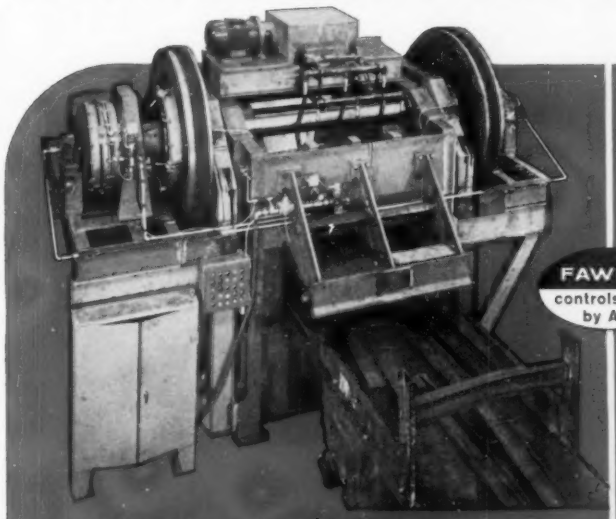
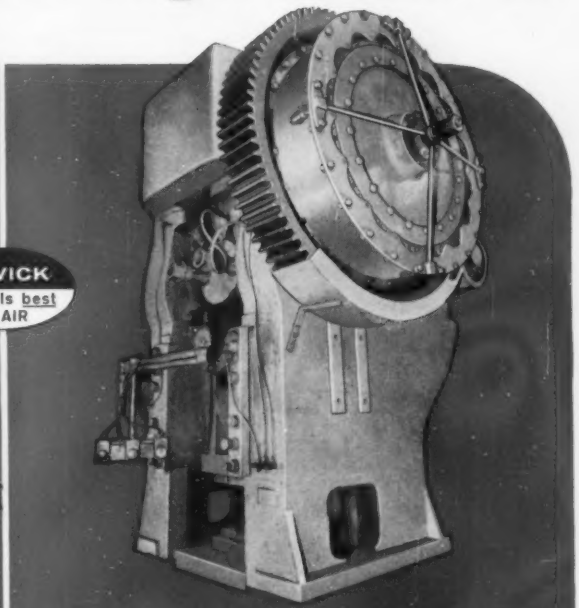
# DESIGN or MODERNIZE HEAVY CYCLIC MACHINES

## ...with Fawick VC Ventorque Clutches



FAWICK controls best by AIR

**NEW** rotary scrap shear incorporates advanced dual drive system using a Fawick VC Ventorque Clutch in each of two flywheels for synchronized power transmission. Clutches engage opposite ends of main drive shaft instantly, and simultaneously, to avoid shaft twist and provide even knife pressure during operation of the 585-ton-capacity machine. Automatic self-adjustment for wear assures equal torque transmission at opposite ends of shaft, cycle after cycle. Dual element VC Ventorque Brake at shaft end (left) provides braking torque. Shear was designed and built by The Hill Acme Company, Cleveland.



**MODERNIZATION** of this 600-ton press at major automotive plant has increased production and reduced maintenance downtime. Press Conversion Package includes crankshaft-mounted Ventorque Clutch and spring-applied CS Brake. Since installation three years ago, downtime due to replacement of clutch or brake parts has been completely eliminated.

## . . . for *maximum production under severe conditions*

FAWICK VC Ventorque Clutches and Brakes provide the kind of rugged-duty power transmission that boosts production and precision on even the heaviest machines.

Machine operating speed or efficiency can be increased because Ventorque Clutches respond instantly and accurately. Drum-type air clutch design incorporates ventilated construction for continuous cooling. This keeps torque capacity high and clutch performance at its peak under the toughest operating conditions. Simplified design and cool operation insure long friction life and extremely low clutch maintenance costs.

Ventorques are available in 14 standard sizes with torque capacities from 27,000 to 1,800,000 in.-lbs. at 75 psi. Whether used as original equipment or for modernization, these units are easily installed on all types of heavy cyclic machines.

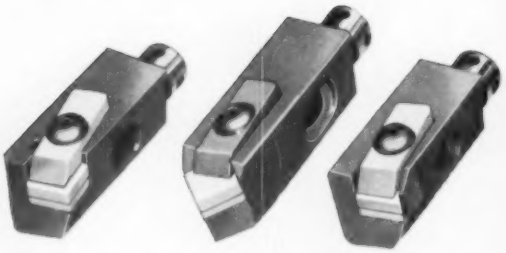
For complete engineering information and consultation on your application, contact your nearest FAWICK representative or the Home Office.

**you can design or modernize these machines with VC Ventorque Clutches:**

- power presses
- shears
- draw benches
- cut-off machines
- benders
- rolling mills
- upsetters
- seamers
- crankshaft lathes

**FAWICK AIRFLEX DIVISION**
**FAWICK CORPORATION**
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK AIRFLEX
INDUSTRIAL CLUTCHES AND BRAKES



Two-dimensional adjustment. Positive and negative rake.

Radial adjustment. Positive rake only.

# NEW KENDEX* UNITS . . .

## for building special tooling more economically

These standardized Kendex units provide a versatile and economical "building block" approach to developing multiple-insert bars and heads for precision machining. They offer many advantages:

1. Only simple milling operations required to provide pockets for Kendex units—much more economical than placing inserts directly in head or bar.
2. Easy to install and remove. A small stock of standard units will service many bars and heads for different operations.
3. Easy adjustment of bore diameter and shoulder length for precision tolerances. Reduces set-up time . . . keeps expensive machines producing.
4. In case of accident, damaged units are quickly replaced.

Other important features are: easy access to adjustment screws; adjustable feature permits compensating for insert wear; all units utilize standard Kendex inserts; positive chip control.

Get complete information about these new cost-cutting Kendex units from your Kennametal Carbide Engineer. Trained to analyze tooling applications and backed by our headquarters staff of tooling specialists, he may be able to help you reduce machine down time, improve production, and increase profits. Ask him for booklet "Kendex Tailored Tooling" or write direct to KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

34230

**See these new KENDEX units**
**at Tool Show in New York—Booth 2445**

INDUSTRY AND
KENNAMETAL
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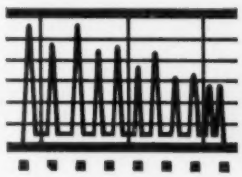
# IF you want to control

## and improve the quality of your product

## with measurements displayed

## on a dial . . . in an air column

## or in signal lights

## on a panel or a chart 

*See them at Booth 1414, Tool Show, May 22-26*

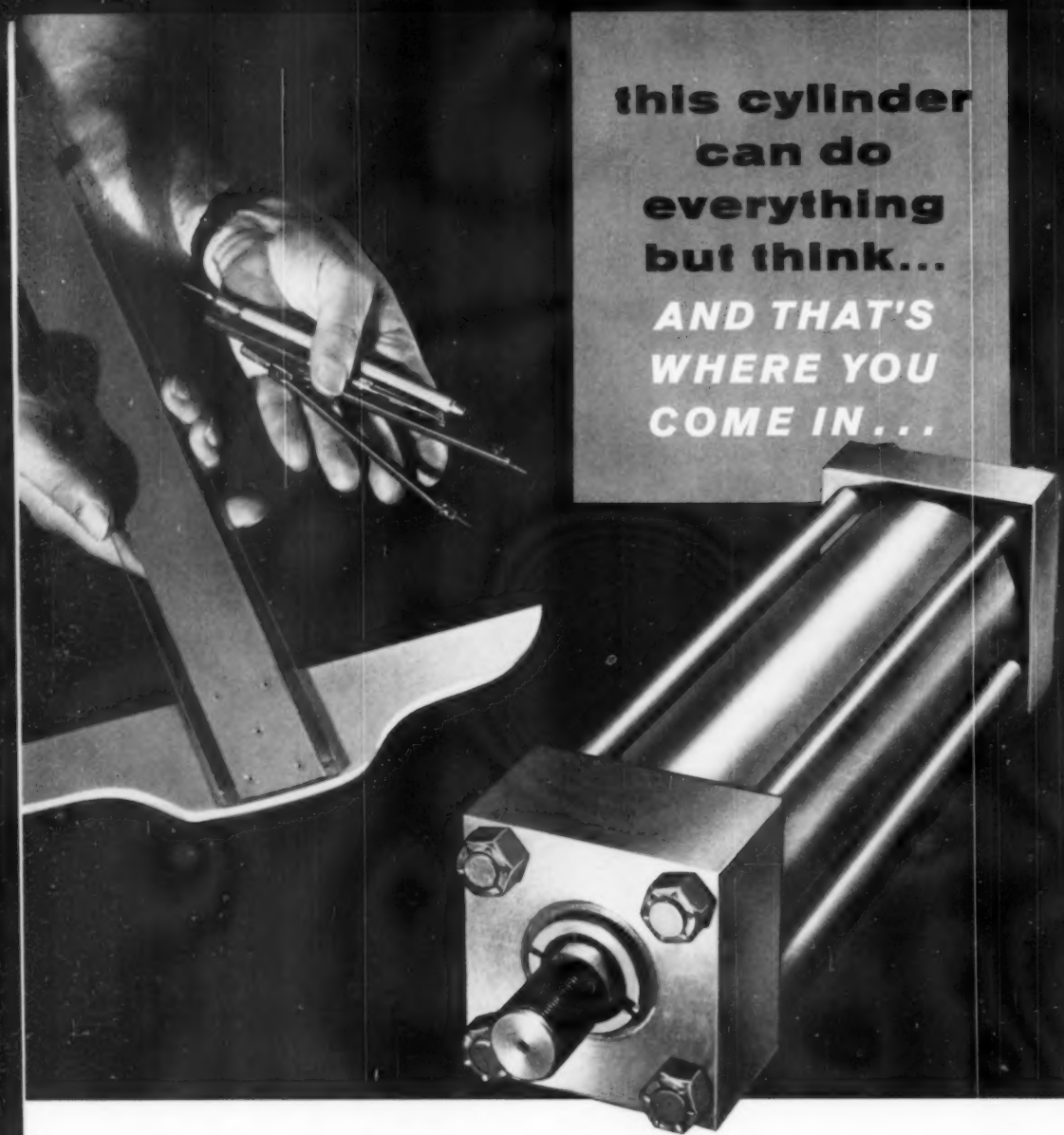
## there'll be no IF in the results

## when you measure with Sheffield gages

The **SHEFFIELD** Corporation — Dayton 1, Ohio

*A subsidiary of The Bendix Corporation*

Inspection Gages, Dimensional Control Instruments, Machine Controls, Automatic Gaging & Assembly Systems, Measuray® X-Ray Thickness Measuring, Crushtrue® & Multiform® Grinders, Cavitron® Ultrasonic Machine Tools, Press-Pacer® Transfer Units, Large Dies, Tooling, Contract Manufacturing.




A cylinder doesn't think but you do—and when you turn your thoughts to how a machine can perform, a lot of things can happen.

The cylinder responds instantly when activated, and does exactly what you tell it to do with pre-set adjustments. You can synchronize it with the motion of related machines or attach it to a moving machine.

It will produce almost any kind of motion—and do so *without the use of complex mechanical contrivances!*

For more information about Logan products, just fill in the coupon below.

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***Check the items you want, fill in your name and address, tear out and mail to:***

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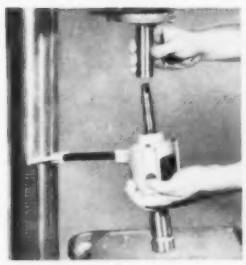
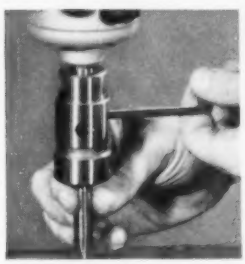
# IT'S A FACT!

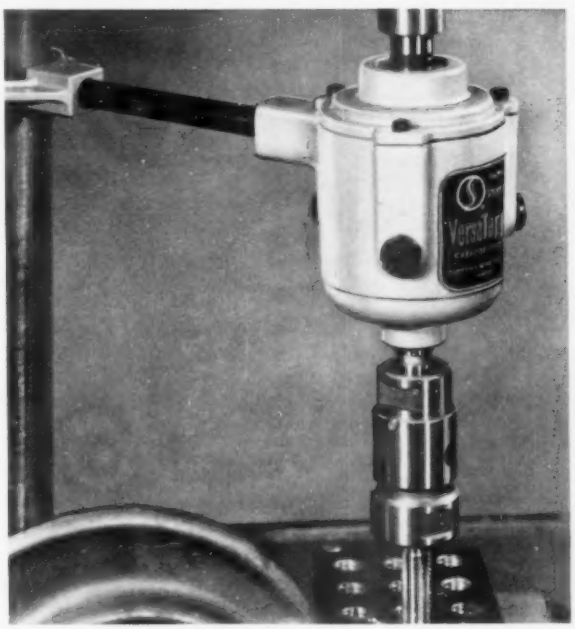
## You can tap 1/2" holes with a light drill press and Supreme's New VersaTAPPER®



Shaft of Model 6100 is held in drill press chuck. No. 6200 (above) has Tapered spindle.



Supreme Accutap Chuck is standard equipment with VersaTAPPER. Capacity 0-½"



VersaTAPPER is a compact precision-made tapping unit. Fits any drill press . . . features half-inch capacity range plus 4-time increase in torque. Easy to install. Simple and quick to remove after use.

**VersaTAPPER...**
operates easily in any material
. . . with widest capacity range
. . . yet costs far less

**JUST $63 COMPLETE**

The *new* VersaTAPPER has scored an instant success with production people everywhere. It has more versatility than other tapping devices. It has the *widest capacity range*—from 0 to ½", but depending on application, use of taps smaller than No. 10 is limited. It develops *more power*—makes the tapping of ½"-13 holes a simpler matter, even with light duty drill presses. VersaTAPPER is *simple to use*—can be successfully operated by anyone in your shop.

All of these features at the remarkably low price of $63.00 complete marks VersaTAPPER as a product you must see at the first opportunity. It's available at your local Supreme Chuck distributor. Call him soon.

**Supreme**
**PRODUCTS CORPORATION**
2222 S. CALUMET AVENUE • CHICAGO 16, ILLINOIS

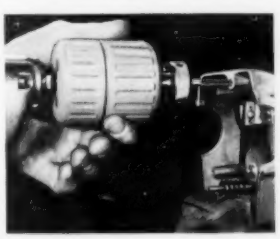
**You get more from power tools with Top Quality Supreme Accessories**

### Supreme Brand Chucks

Noted for unmatched quality. The widest range of sizes and types...one for every machine in your shop. Exclusive Supreme hardening means greater accuracy—longer wear.

### Supreme Versamatic

Reversible speed reducer for portable drills. Fits all makes—permits their use for power screw driving, nut running and heavy duty drilling. 7 to 1 reduction means high torque increase. *A fine tool.*



### Supreme Push-Pull Tapper

Like the Versamatic, but made for the single purpose of tapping with portable drills. Reverses instantly for tap removal. Handles taps up to 5/16" diameter. Top quality. Simple to operate.

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PRECISION A-S-R PRODUCTS

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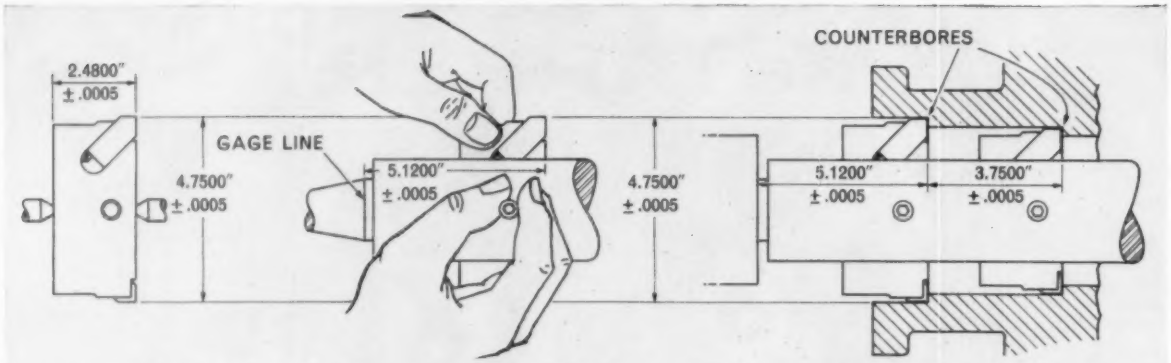
Use Reader Service Card, CIRCLE 293

# HOW TO CONTROL MACHINING ACCURACY FROM THE TOOLROOM

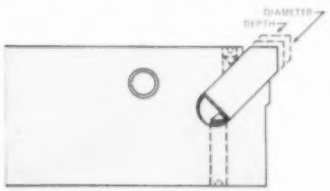



**1.** Assembled Davis block and cutters are ground for diameter and face-to-back-of-tool dimensions *in the toolroom.* Accurately located grinding centers make the block its own arbor, assuring precision tolerances.

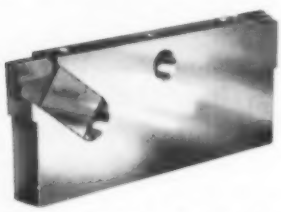
**2.** Toolroom accuracy is retained when block is mounted in Davis precision machined bar. A single taper locating screw accurately centers the block and locks it securely against the back of the slot, providing rigid precision alignment for depth as well as diameter.

**3.** Original preset depth and bore accuracy are translated to precision boring by block and bar. Accurate location of bar slots provides precise spacing between blocks for boring, facing, and other combined or successive operations.

**CUTTER EXTENDS AT AN ANGLE FOR REGRINDING**




Both bore *and* depth dimensions can be maintained when cutter is reground — an *exclusive* Davis feature *available at no extra cost.*



**Expandable two-cutter and multicutter blocks** can be toolroom ground to desired tolerances. Adjustable for regrinds.

**Two-cutter blocks** with throwaway tips. Accuracy of precision carbide inserts permits rough boring to .004" tolerances.

**Solid block cutters** also are available.

## DAVIS PRESET BORING TOOLS eliminate cut-and-try toolsetting, reduce nonproductive machine time, and meet all the requirements of automatic and tape-controlled machines.

Davis expandable cutter blocks and solid blocks are *preset* by grinding to accurate bore and depth size *in the toolroom.* Accuracy of blocks with throwaway inserts is preset by the precision insert tolerances. There is no cut-and-try toolsetting to tie up costly machines and waste valuable production time.

A major feature of Davis expandable cutter design — not available in cartridge or other block-type tooling — is the angular cutter adjustment which permits grinding both the OD and the face of the cutter *without* sacrificing accurate depth dimensions. (See illustration at left.)

You are further assured that bore depth and diameter will be accurate when using tape-controlled or other automatic machines which bore according to programmed depth. By holding the face-to-back-of-block dimensions and accurately locating the block slots in the boring bar, Davis is able to furnish a boring tool package that maintains exact relationships between tools for boring, backfacing, counterboring, etc.

Standard Davis bars and block-type tooling are available for boring, backfacing, counterboring, chamfering, facing, form-cutting, or combinations of these operations within a ¾" through 17" diameter range. *For more information,* call your Davis distributor or send for literature.

**Two new catalogs** — Complete specifications, pricing, and ordering instructions for the Davis block tooling system are given in Block Catalog D-510-A and Bar Catalog D-520-A. Ask for your copies today.

GIDDINGS & LEWIS

## GIDDINGS & LEWIS MACHINE TOOL COMPANY

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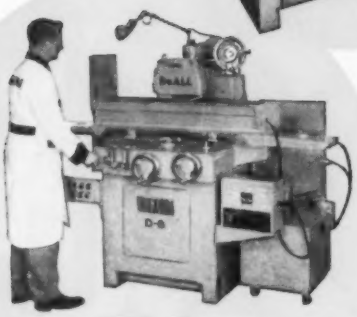
Boring bars • block tooling • micrometer-adjustable flycutter boring tools • stub boring tool sets • boring heads • drilling and tapping heads • preset tooling for VTL's and VBM's arbors and sleeves • adjustable drawkeys • setup accessories

**MODEL D6-1**
Chuck Size
6" x 18"
Wheel Size
7" x ½" x 1¼"

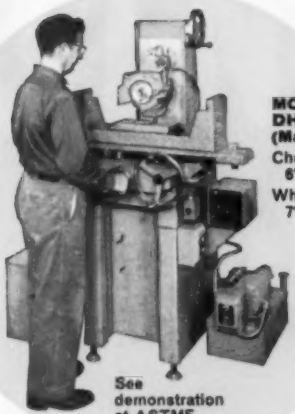
# A "STANDARD" IN ANY SHOP!

AT NEW LOW PRICES FROM $1450.00
MODEL DH-612



**MODEL D8**
Chuck Size
8" x 24"
Wheel Size
8" x 10" or 12"

**MODEL D10**
Chuck Size
10" x 30"
Wheel Size
12" or 14"



**MODEL DH-612 (Manual)**
Chuck Size
6" x 12"
Wheel Size
7" x ½" x 1¼"

See demonstration at ASTME Show, May

**Type of chuck, SELECTRON® magnetic control and DoALL's "Cool Grinding" are optional.**

## DoALL PRECISION SURFACE GRINDERS

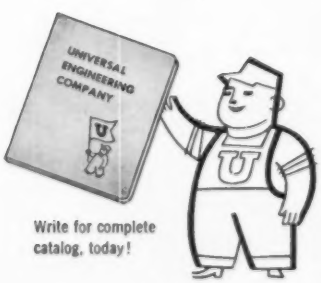
**offer performance plus in accuracy, ease of control, versatility**

You'll get high precision more easily with *any* DoALL surface grinder. And whether it's a hand-operated or a fully automatic production machine, it will help you save time, cut costs and improve your product. Now, in the four basic DoALL machines shown above, there's still more good news:

- **NEW SIZES**—from 6" x 12" to 10" x 30"
- **NEW SPEEDS**—up to 75 f.p.m. table travel
- **NEW WORK HEIGHT**—full 15" capacity
- **NEW RIGIDITY**—greater sturdiness
- **NEW CONTROLS**—still more convenience
- **NEW ACCURACY**—grind to tenths, with handwheel settings
- **NEW ATTACHMENTS**—full line of accessories, including "Cool Grinding"
- **NEW WHEEL CAPACITIES**—7", 8", 10", 12", 14"

What do these features mean to you? Just this: (1) DoALL has taken the guesswork out of surface grinding; (2) every part is precision ground, perfectly flat and parallel; (3) surface finish is guaranteed—10 micro-inches R.M.S. or better from standard wheels; (4) you can handle more parts more accurately (surface grinding, crush form grinding, etc.); (5) lowest grinding costs—always. *Ask for free bulletins or demonstration in your plant. Call your DoALL Store today or write:*

## The DoALL Company, Des Plaines, Illinois

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it pays to use UNIVERSAL DRILL BUSHINGS

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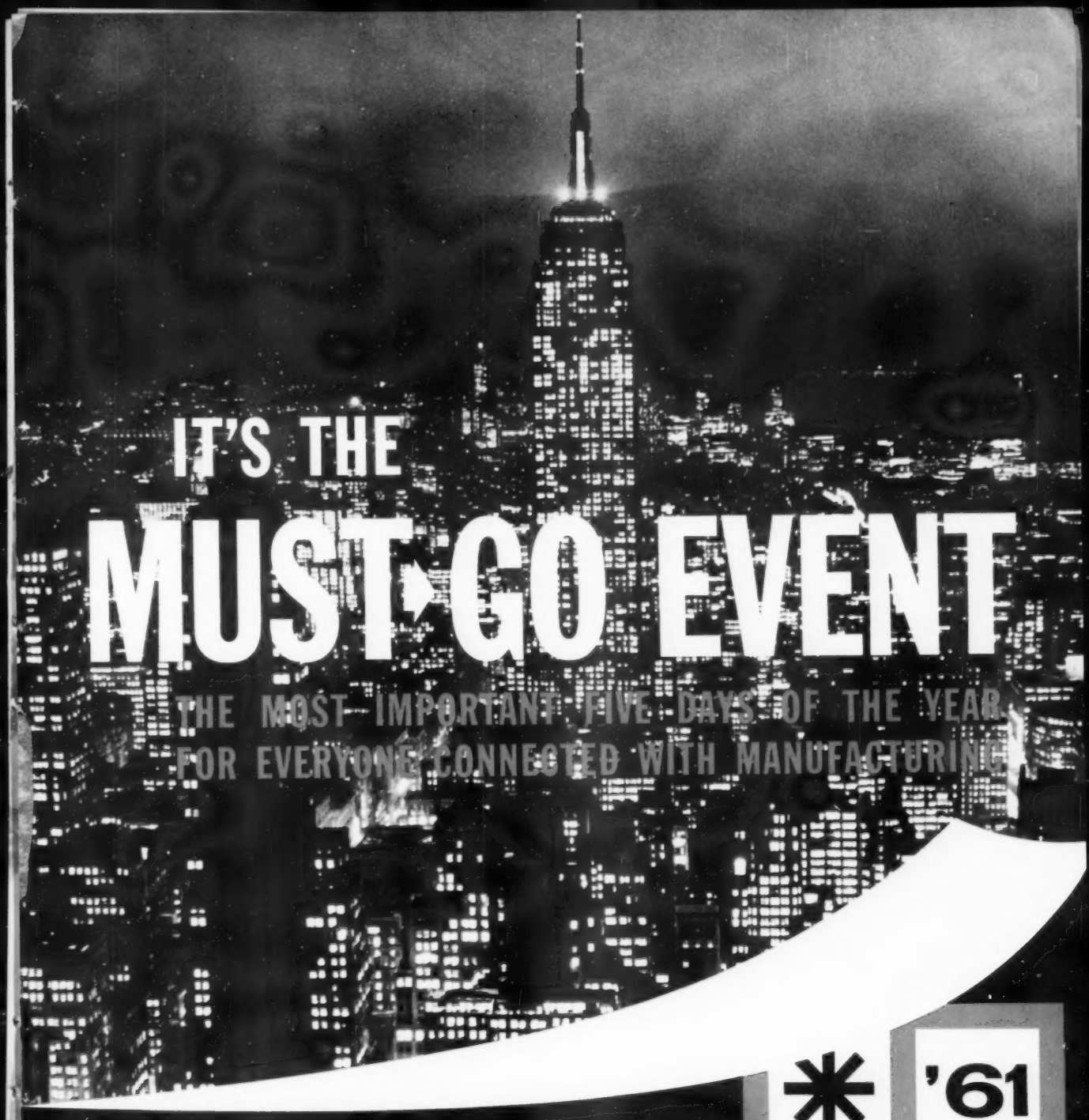


This is the national show that gives you twice as much for your money—everything that's new and important in manufacturing, production, engineering, research and development—plus fabulous New York City, too.

You'll see the very latest in all types of manufacturing equipment . . . you'll see improvements in current techniques and procedures . . . you'll see developments so fresh from the drawing boards that you're virtually looking at "originals" . . . and you'll see display after display of equipment and parts and techniques . . . all designed to help you meet and conquer the challenges of both today—and tomorrow.

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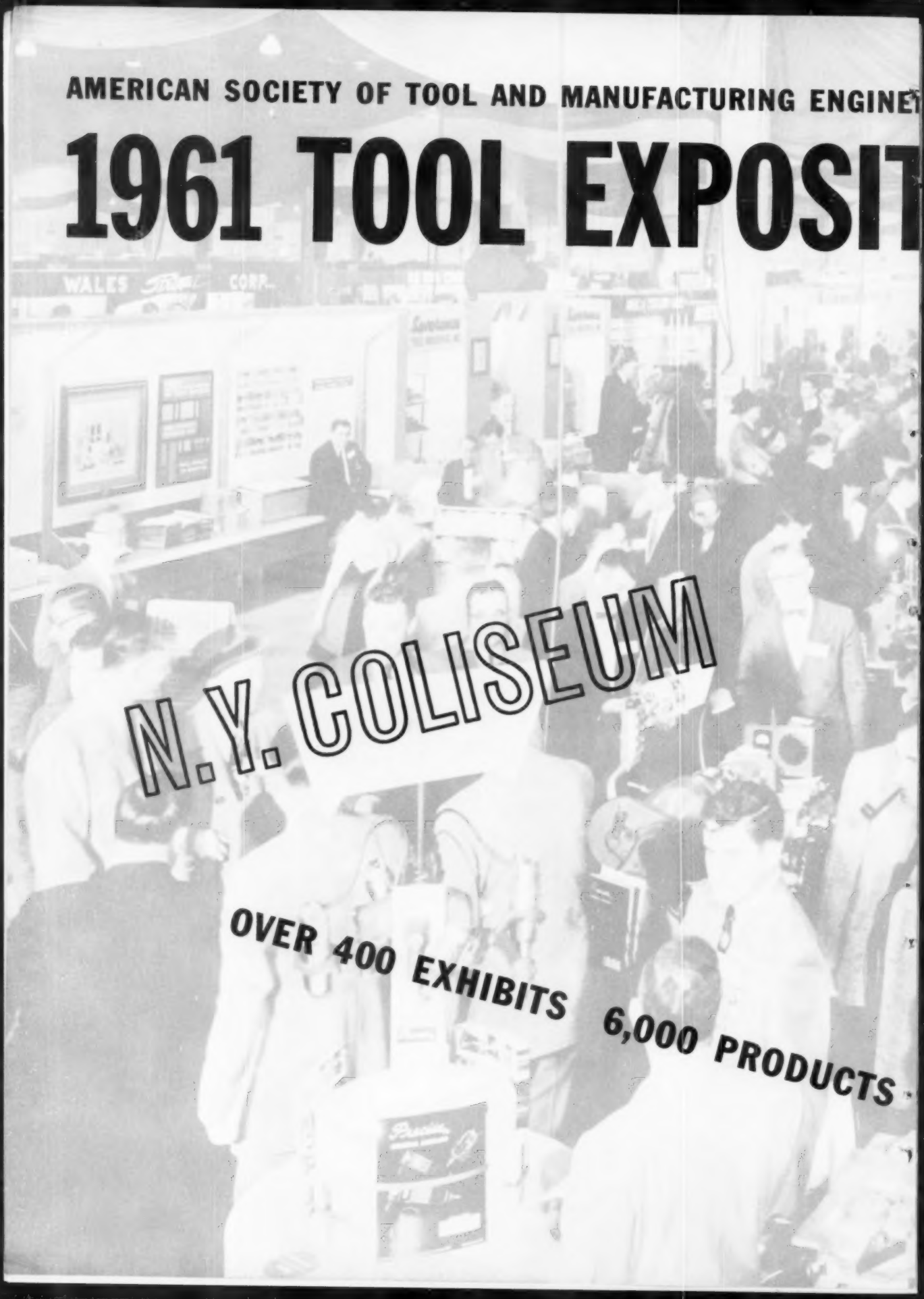
AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEE

# 1961 TOOL EXPOSIT

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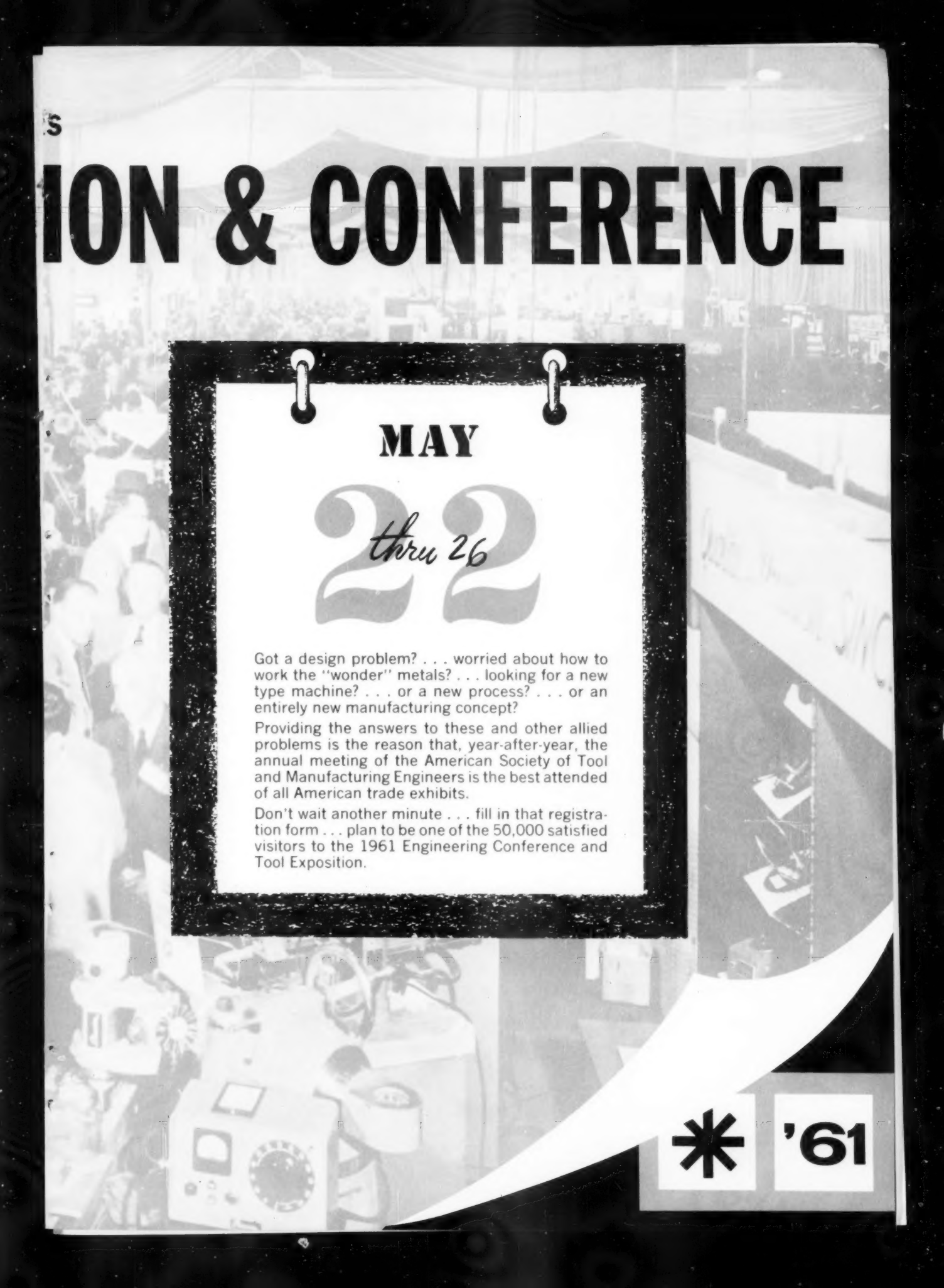
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thru 26
Got a design problem? . . . worried about how to work the "wonder" metals? . . . looking for a new type machine? . . . or a new process? . . . or an entirely new manufacturing concept?
Providing the answers to these and other allied problems is the reason that, year-after-year, the annual meeting of the American Society of Tool and Manufacturing Engineers is the best attended of all American trade exhibits.
Don't wait another minute . . . fill in that registration form . . . plan to be one of the 50,000 satisfied visitors to the 1961 Engineering Conference and Tool Exposition.
'61

# INFORMATION & INSPIRATION

Just take a look at the typical information-packed conferences and symposia scheduled below, and we think you'll agree . . . you can't help but find here the information and inspiration you and your top people need to successfully meet today's conditions, tomorrow's challenges.

**Surface Metrology Seminar**
Surface Specifications, Measurement Techniques, Predictions of Future Requirements and Developments

**Material Removal Symposium**
Ultra High Speed, Electrolytic and Electron Beam Machining

**Manufacturing with Numerical Control Systems**

**Use of Computers in Manufacturing Operations Management**

**Application of Explosives in Metal Forming**

**Workhold Developments**
Electrostatic chucking and Fiberglas reinforced Plastic Clamping

**Numerically Controlled Machining Operations**

**Operations Research . . . Process Planning**

**Machining Malleable Iron and Cast Iron**

**Press Tooling and Die Design**

**Heat Treating Instruments**

**Metal Cutting Carbides**

**Work Simplification**

**Precision Grinding**

**FOR ADVANCE REGISTRATION** and all the advantages it brings just fill in the form below and mail it NOW, with registration fee to the American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave., Detroit 38, Mich. If you mail **before May 1st** you will receive, FREE, a $10,000 ACCIDENTAL DEATH and DISMEMBERMENT POLICY covering you, 24 hours a day, from the time you leave home until you return . . . **plus** a time-saver Guest Badge that eliminates waiting in line at the Coliseum. After May 1st, bring your filled out registration card with you . . . save the time of filling it out at the Show.

## ADVANCE REGISTRATION CARD

'61 ASTME 1961 CONVENTION
NEW YORK COLISEUM • MAY 22 THRU 26

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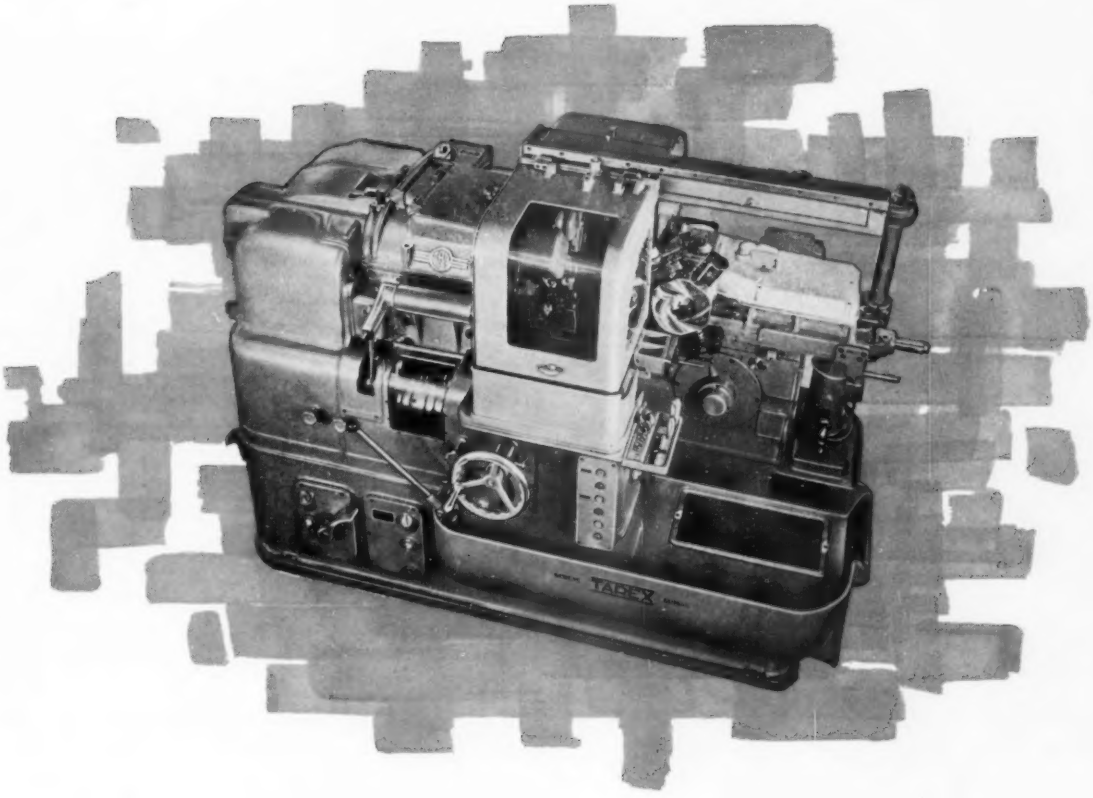

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**Because the TAREX is a Swiss single spindle automatic,** designed and engineered for the production capacity of a **turret lathe with**

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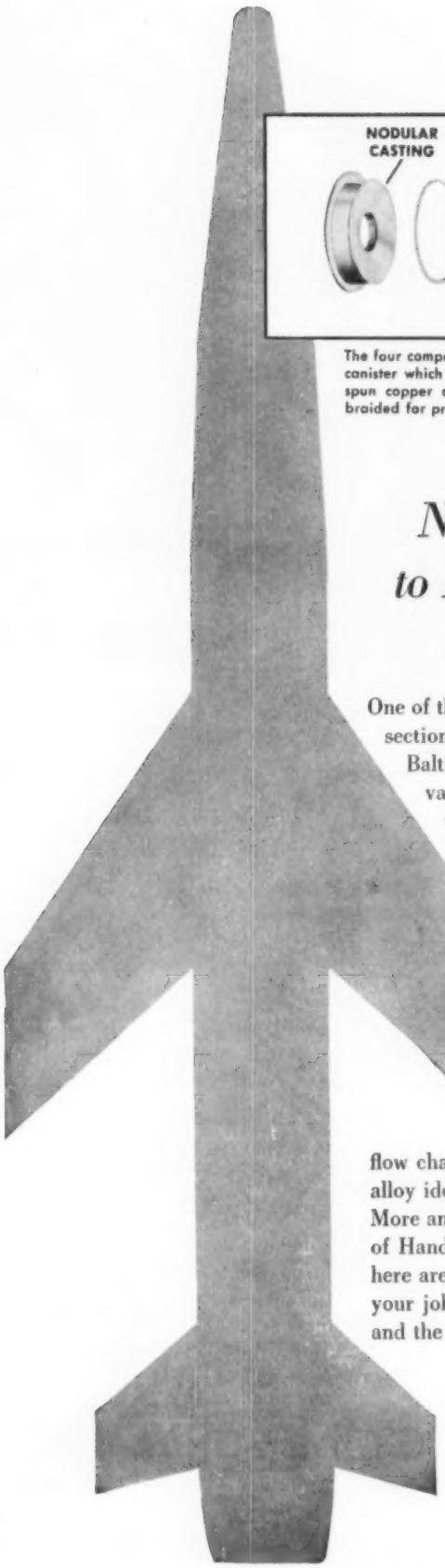

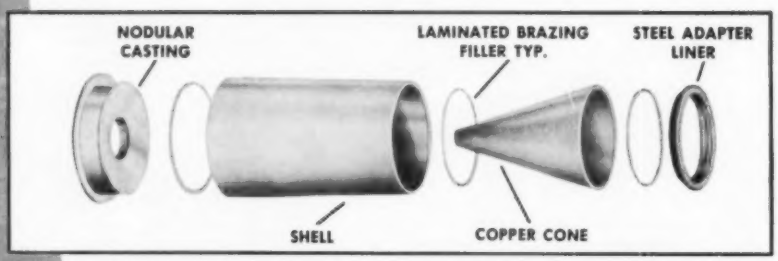


The four components of the nose assembly—nodular iron casting; low-carbon welded steel canister which measures 34" long, 15½" diameter at one end and 17¾" at the other; spun copper cone and low-carbon steel ring. The thinner rings are Easy-Flo 45 wire braided for precise alloy position and control.

# *Martin Develops New Induction Heating Methods to Braze Lacrosse Missile Assembly With* EASY-FLO 45

One of the largest assemblies yet brazed by induction-heating techniques is a section of the Lacrosse missile being manufactured at The Martin Company's Baltimore Division. During development, one problem was posed by the variety of metals used. First it was necessary to braze a low-carbon welded steel canister and nodular iron casting. Then, to complete the assembly, a spun copper cone and low-carbon steel ring were joined to the canister. An induction coil was designed by Martin to accomplish this critical operation. Temperatures had to be restricted between 1300 and 1350°F to prevent a transformation change to the crystalline structure of the nodular iron. Martin's Materials Engineering Laboratory made careful examinations of this assembly and found that Handy & Harman Easy-Flo 45 Silver Brazing Alloy and B-1 Flux make possible the strong, uniform joints necessary to meet the stringent requirements the Company has set. Its low-working temperature, high strength, fast penetration and flow characteristics are only a few of the features which make this brazing alloy ideal.

More and more aircraft and missile components are being made with the aid of Handy & Harman silver brazing alloys and flux. The products described here are just two of the many available to help solve your problems...make your job easier and quicker. For a more complete picture of silver brazing and the advantages it offers you, write for your free copy of Bulletin 20.

*Your No. 1 Source of Supply and Authority on Brazing Alloys*

**HANDY & HARMAN**

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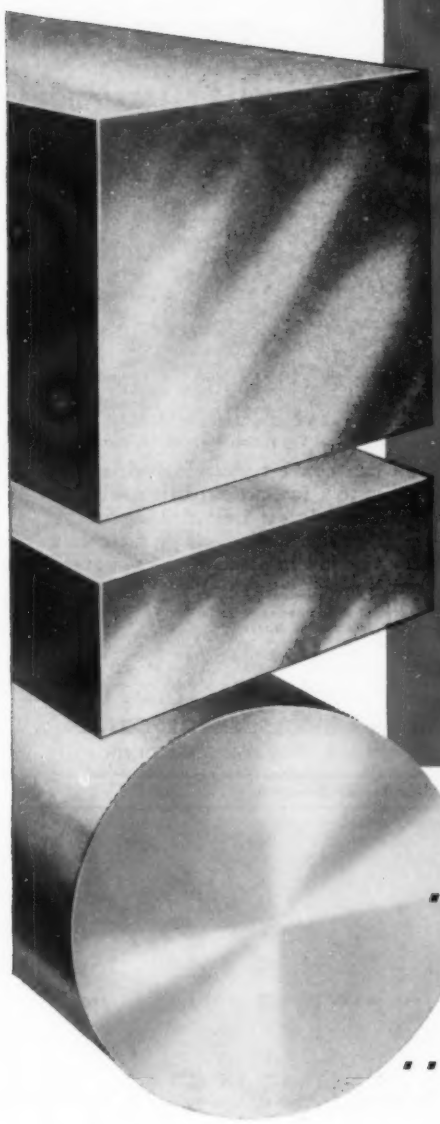

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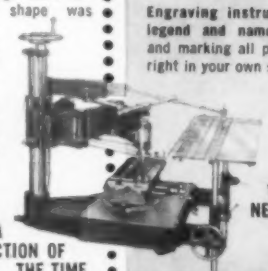

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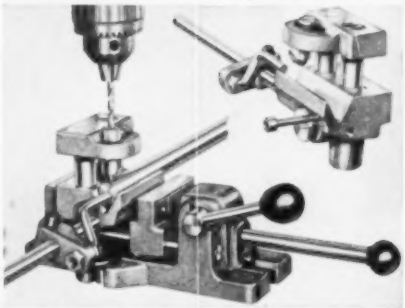

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*Series Cutting Grades*

## to boost production–extend tool life up to 200%

If you're tooling-up for a really tough cut, try Carmet's new 700 Series Cutting Grades. Make one super-duty tool do the work of two or three—on any steelcutting job, including superalloys.

Carmet's 700 Series is a new, premium group of carbide grades just released after exhaustive field trials. Results were conclusive. These carbides stood up under the roughest interrupted cuts going. They gave longer tool life than competitive grades in the same application class. And, they produced exceptionally fine finish cuts, even in C-8 precision boring classifications.

Here are the 700 Series Steelcutting Grades, and their applications:

- **CA-704** Hard and dense for the ultimate in finish cuts and precision boring.
- **CA-711** Ideal for medium to finish cuts in the general purpose category.
- **CA-720** Tough and thermal shock-resistant for medium and heavy cuts, including interrupted cuts.

These new Carmet Grades combine edge wear and crater resistance with an unmatched ability to endure shock. The 700 Series will outperform other groups of tools in any C-5 to C-8 application. Take a look at a few customer trial reports:

"Turning tapered, slotted, forged SAE 4140 valve plugs . . . formerly got 8 finished pieces per cutting edge. Now get up to 25 pieces with CA-720 on a tough, interrupted cut!"

"Turning OD of universal joint ears . . . now getting 177 pieces with CA-720 against 135 with former tool."

"On SAE 1035 rotor shafts . . . got 7 more shafts per tool with CA-711. And K Monel shafts . . . got more from 9 CA-711 tool corners than 12 corners on triangular inserts formerly used."

"On SAE 4320 forgings . . . a whopping 242 pieces with CA-720, against 209 with previous Carmet 600 Grade, 198 with best competing tool."

Remember, for less demanding operations, the 600 Series Cutting Tools will continue to be sold by Carmet. But for the really tough cut . . . when you've got to make chips on a mean, tool-buster of a job . . . this kind of performance from the 700 Series will save you time. And, cost you less than competing premium grades!

They're doing just that in shops all over the country . . . right now! Try them, just once, on your job. Your local Carmet Distributor has them in stock. Contact him for more information, or write: ***Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. TE 5-1.***

**CARMET 700 SERIES CATALOG SUPPLEMENT NOW AVAILABLE**

There's a new Supplement to the Carmet Catalog C-16-B, listing tool and insert styles, and prices for the new 700 Series. Contact your local distributor, or write Carmet direct.

2898

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- **Available with flute lengths up to 4X diameter Plus**
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64th sizes are stock items. Ball end mills and other decimal sizes available in 2 to 4 working days from receipt of order.

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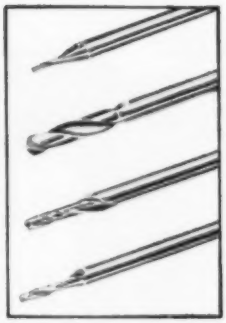

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The new Holomatic family of "compacts" . . . the Size "J", are self-contained, reciprocating quill type power-feed units for use on production drilling, reaming, facing, tapping, threading operations. Used individually or in groups with manual or automatic cycling. Available in 3 "compact" models with 3 power-feed styles with built-in cycle and movement control systems to meet every conceivable need more efficiently and economically.

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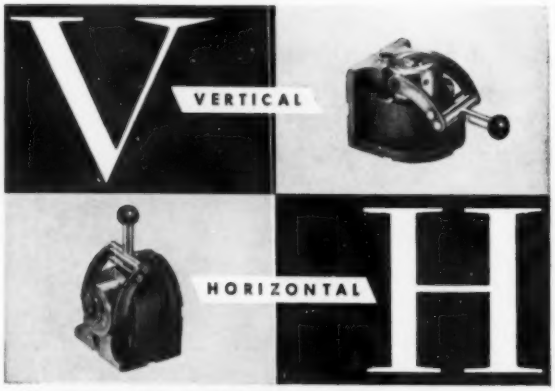


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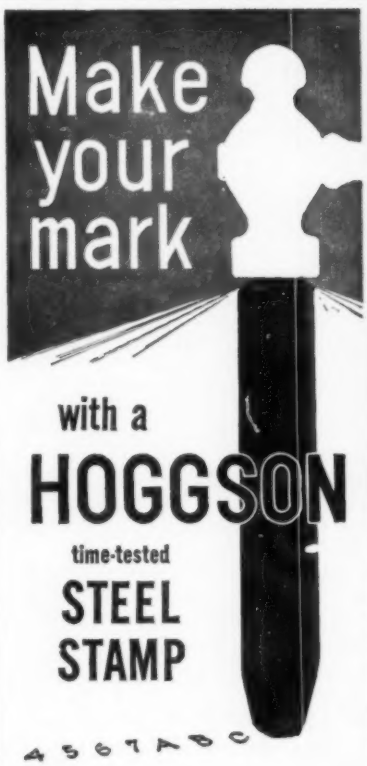

Whatever your need for product marking may be, Hoggson stamps can meet it. They are made of finest alloy steel, heat-treated to stand continuous impact without breaking face or mushrooming body. Ask about our inspectors' symbol marking hammers, type holders, hand stamps with locating or positioning attachments, marking dies for hand and machine use.

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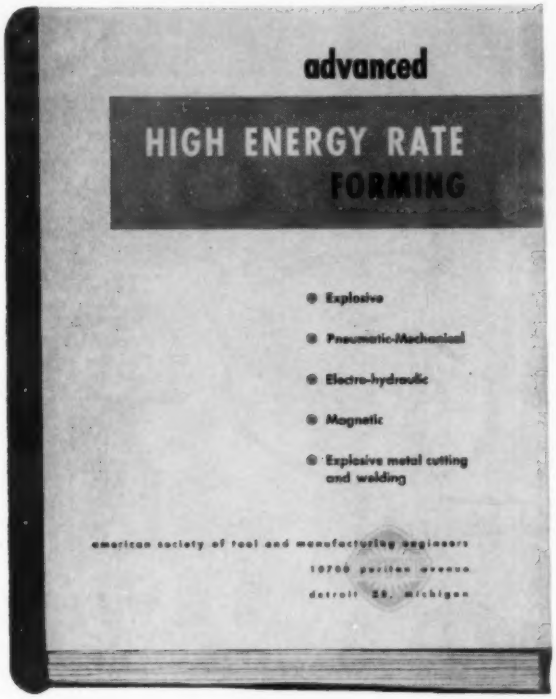


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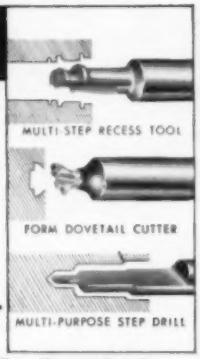


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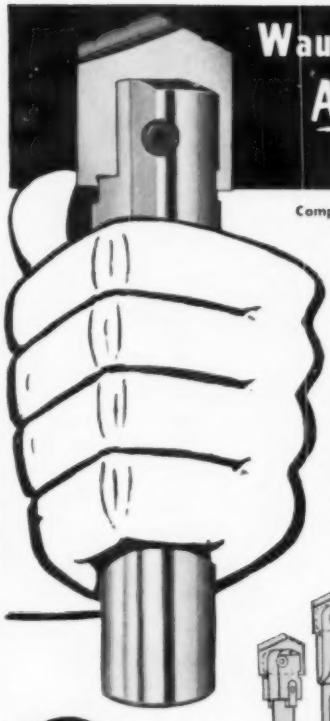

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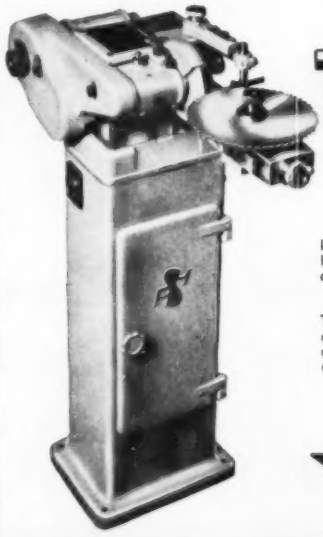

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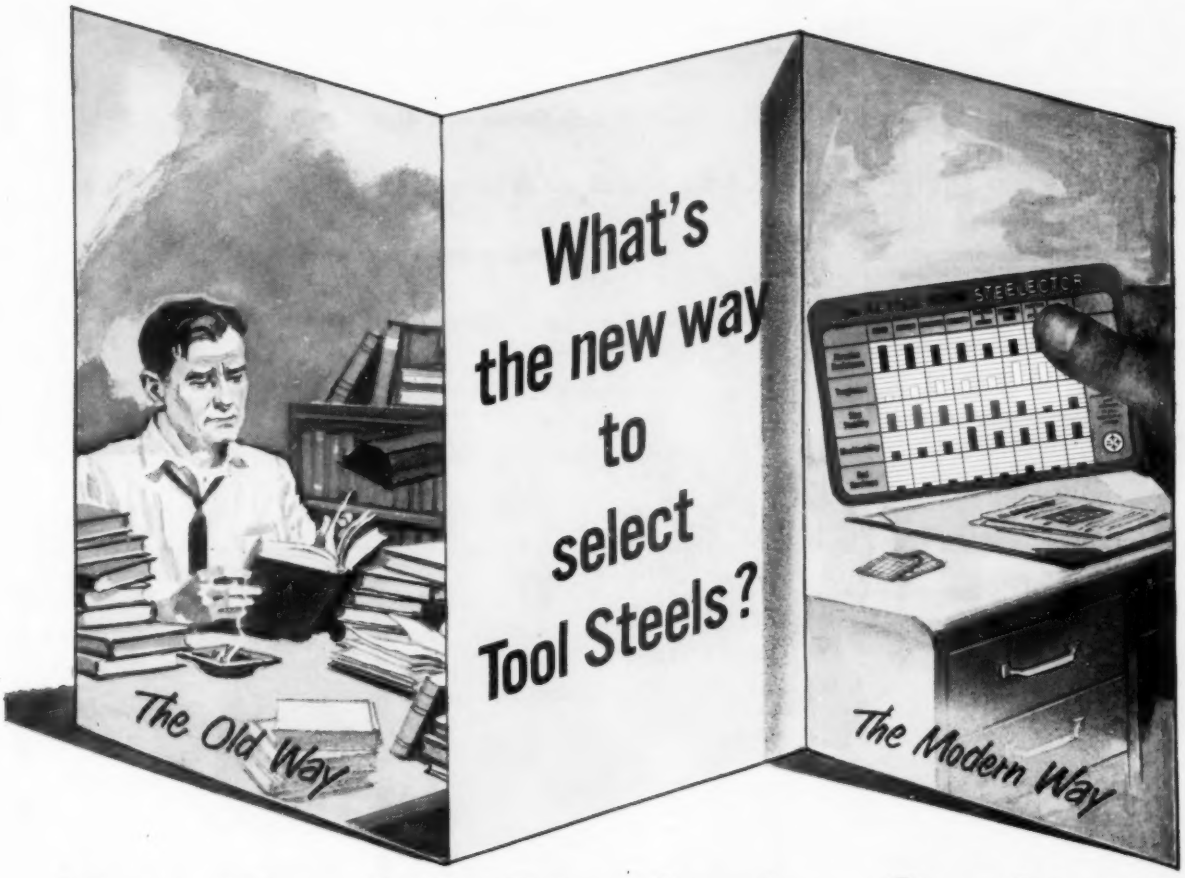


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Bar graphs show how the steels compare so it's simple to check the properties most important to you and pick the grade with the combination of properties you need. The three STEELECTOR Cards list grades that will suit 96 percent of all tool steel applications—as shown by an actual survey of the authoritative A-L Tool Steel Handbook.

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You can put full confidence in STEELECTOR grades because they have been selected from the complete line of A-L Tool Steels and are made under the rigid quality control standards common to all A-L products.

To take the guesswork out of tool steel selection, ask your Allegheny Ludlum sales representative for your copy of a colorful STEELECTOR Bulletin that contains all three STEELECTOR Cards, describes the tool steels, and explains the Data Stock Lists, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. TE 5-2.***

STEELECTOR PROGRAM

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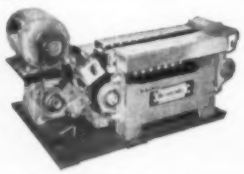

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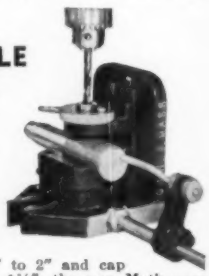

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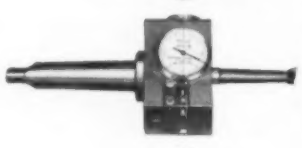

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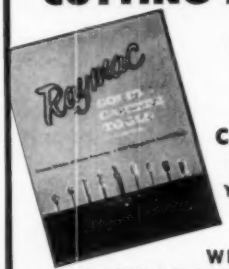

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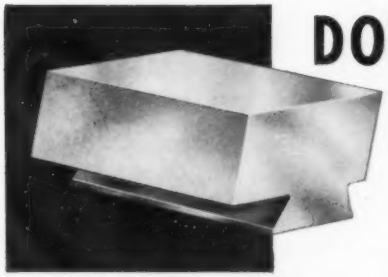

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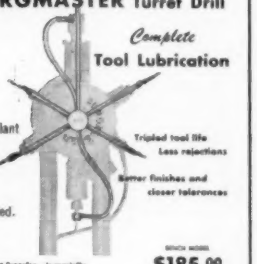

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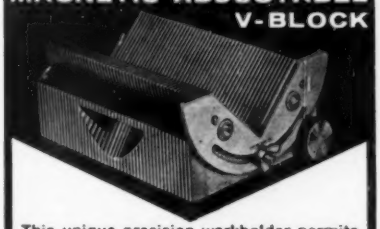

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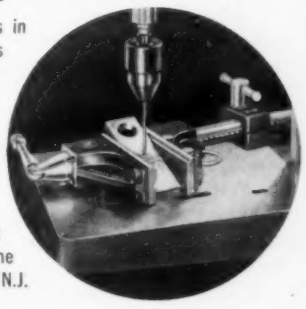

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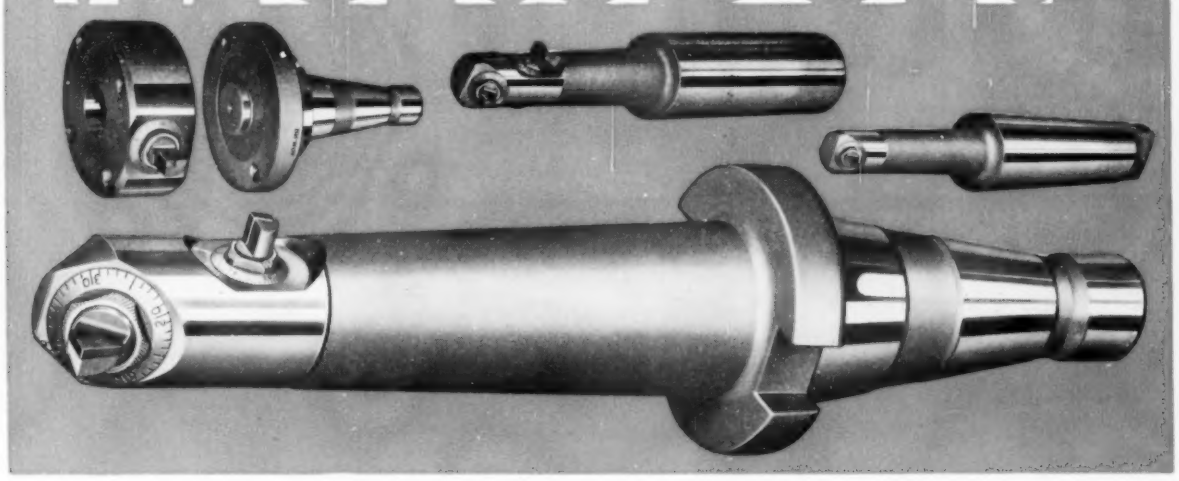

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